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FREDERIC RICH HENSHAW, D.D.S., F.A.C.D., Indianapolis, Ind.
President Elect, American Association of Dental Schools

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Original Communications

EXPANDED PATTERN CASTING TECHNIC*

By C. S. VAN HORN, D.D.S., Bloomsburg, Pa.

MAY 24, 1910, at the annual meeting of the Susquehanna (Pa.) Dental Association, the expanded pattern technic was presented to the profession.[1] This technic is based upon investment of the wax pattern at a temperature sufficiently above tooth cavity temperature to compensate for the shrinkage in the gold which is in excess of any change in the mold at the time the cast is made. In fact, all of my writings on dental casting, both prior and subsequent to that paper, have been directed largely toward an endeavor to place the process upon a scientific basis.

This present paper is intended as a comprehensive outline of the knowledge, data, etc., necessary to establish and execute a cast gold inlay technic of the highest efficiency both as to the technic *per se* and the resultant restoration.

*Received for publication, March 6, 1930.

*Read before the Pennsylvania Dental Society, Scranton, Pa., May 14, 1929.

1. Van Horn, C. S.: Dent. Cosmos, 52:873 (Aug.) 1910.

During the nineteen years since its introduction into dentistry, the expanded pattern technic has been refined and improved by me and modified by others, but dentists are severely handicapped in doing research and experimental and developmental work which has to do with the physical properties and the behavior of the materials necessary to the casting process, and when that work is attempted in conjunction with our daily practice and in our laboratories with their almost total lack of equipment suited to such work, progressive improvement, based upon accurate data, must of necessity be exceedingly slow even though the period of time is, as it has been, rather long.

Review of the literature will disclose that casting technics, though numerous and varied, have been based largely upon opinion rather than upon fact, a deplorable condition which brought forth Wilmer Souder's many pertinent comments,[2] of which the following is typical:

2. Souder, Wilmer: Selection of Dental Materials, J.A.D.A., 14:189 (Jan.) 1927.

If there is another problem in dentistry concerning which one can read more and learn less, articulators excepted, I have failed to find it. . . . I have described to you, in terms of individual effects, properly combined, a result that will doubtless be claimed by many operators at this convention as arising from the use of some special wax, plaster or accelerator, oven, flux, or special gold alloy. Thousands of dollars have been spent encouraging lecturers who offer special technics, recommend special materials, etc., and who give no reason or proof to justify their claims. Inlay C, Figure 6, was made in strict accordance with a technic outlined before a local organization, which spent much time and money in a sincere attempt to solve the inlay problem. It is evident that they were offered a "gold brick." . . . I am unable to understand the lack of interest by some individuals in consistent, fundamental research looking toward the establishment of standards for material and technics.

In 1925, I endeavored to show conclusively what occurred when castings were made by technics which ignore the physical behavior of the materials which enter the process.[3] In that series, the material assistance and hearty cooperation of a number of men were unselfishly given; and the data, etc., were handled in such manner that no one knew the final results until the cooperating laboratory made its report; the main object being honestly to endeavor to segregate truth from fiction, to ascertain definitely, if possible, what technic rather than whose technic was best and, especially, to determine what was essential to a standardized technic.

This series was followed by reports from R. L. Coleman[4] and Wilmer Souder[2] on the Bureau of Standards' dental research in cooperation with the Weinstein Research Laboratories, and while those reports added very materially to our previous understanding of the subject, a conclusive answer, as was clearly stated, was not given to our casting problems, the facts being that research which is in definite accord with conditions as they actually exist is essential before there can be established a definite cast gold inlay process which will produce, regularly and uniformly, castings which are relatively perfect in marginal adaptation with the prepared tooth cavity margins.

To illustrate briefly: There are two methods for determining the proper technic to employ: (1) knowing the exact shrinkage value for the gold to be used and the expansion curves for, and the behavior of, the pattern wax and the investment throughout the temperature ranges and manipulative procedures, the correct temperature at which the pattern must be invested is determined mathematically, as well as the temperature of the investment when the cast is made; or (2) castings are made from wax patterns which have been measured at tooth cavity temperature, and notations made of investing and casting temperatures, etc.

The point I wish especially to stress, in fact, have been emphasizing for many years, is this: To base a cast gold inlay technic upon results obtained from wax pattern dimensions taken at room temperature is to employ a false premise. The field of operation is relatively constant at 95 F. (35 C.), and it is from wax dimensions at this temperature that our calculations must be made. An example: Again referring to Dr. Souder's report,[2] it will be observed that zero dimension of the wax pattern is placed at 82.4 F. (28 C.) and that dimensional changes of the wax and the investment give a total length increment of +1.23 per cent to compensate a contraction of —1.25 per cent in the gold. As a labora-

3. Van Horn, C. S.: Dent. Cosmos, 67:159 (Feb.) 1925.

4. Coleman, R. L.: Dent. Cosmos, 68:743 (Aug.) 1926.

tory proposition that procedure is beyond question, but I repeat that no cast gold inlay technic can possibly reach the maximum in efficiency unless zero dimension, i. e., the point from which dimentional changes (+ or —) are calculated, is placed at tooth cavity temperature, which, in the bicuspid and molar region is, as previously stated, approximately 95 F.; hence, the only wax movement which can be utilized in neutralizing the gold shrinkage is that expansion which occurs at temperatures above 95 F., as shown in the accompanying table.

The Bureau of Standards' dental research is of inestimable value, but it should not be overlooked that while the Bureau has all necessary appliances to make most exacting measurements and physical tests, practical application in the mouth is not a part of the work. Hence, what appears feasible in laboratory practice may not apply to work at the chair. The proposition of selecting a nonplastic pattern wax "fitting this wax, cooling in position, adding small quantities where needed and securing a pattern that fits" at room temperature, while feasible

DIMENSIONAL CHANGES ACCOMPANYING INLAY TECHNIC*

Material	Temperature Interval	Length Increment Per Cent		
Wax	82.4 to 104 F. 28 to 40 C.	+0.72.....	95 to 110 F. 35 to 43 C.	+0.40
Investment	(setting)	+0.20.....	.....	+0.20
Investment	104 to 682 F. 40 to 250 C.	+0.31.....	.....	+0.31
Total increase		+1.23%.....	Actual increase.....	+0.91%
Contraction of gold (to be compensated).....				1.25%

*It will readily be perceived that applying Dr. Souder's technic to work in the mouth, and utilizing the maximum expansion of the pattern wax, as given in Figure 1, there would be a deficiency in the casting of 1.25 — 0.91 = —0.34 per cent; instead of, as stated in the table, 1.25 — 1.23 = —0.02 per cent.

The reason for overstressing tooth cavity temperature when considering casting processes is that, seemingly, clinicians generally are prone to accept, without question, results which are based upon wax pattern dimensions at room temperature and to assume that castings so executed will fit the cavity in the tooth *in situ* just as well as they fit the cavity in the tooth in the laboratory, which is not a fact, as has been proved both clinically and technically by me and is emphasized by Dr. Souder's report.

From observation, experimentation and investigation, coupled with long practical experience at the chair, dealing with all classes of cavities and cast gold inlay restorations, I am convinced that, generally speaking, the making of relatively perfect wax patterns in the tooth cavity in the mouth is the most difficult and exacting part of the entire casting process. By this, I mean patterns which record faithfully all cavity margin rela-

tionships and which, when invested and eliminated, will leave a mold that will, under proper thermal conditions, produce a casting also having exact marginal relationship with the margins of the cavity. The more scientific the investing technic employed, the more exacting, from a technical point of view, is wax pattern making.

Weston A. Price showed conclusively that "stretched pattern wax exhibits elastic properties" when passing from a lower to a higher temperature; i. e., if a piece of pattern wax is warmed and then stretched or bent and held in that condition until it chills to the point of being rigid, and that wax is then subpected to a temperature higher than the temperature at which it was chilled, it will tend to return to its original length or resume its original shape. Hence, when employing the expanded pattern technic, or any modification thereof, it is essential that the pattern wax be manipulated in such manner that stretching or bending be either prevented or eliminated.

Pattern wax may be divided into two classes: plastic and nonplastic. Briefly, a plastic wax is one which is easily bent, stretched or distorted when being placed in or removed from the tooth cavity and has, in my opinion, no place in our inlay armamentarium. A nonplastic wax is one which is rigid at tooth cavity temperature, and will, if sufficient force is applied, break with a clean fracture. Under no consideration should a wax be used which requires chilling below tooth cavity temperature in order that it shall become—which is very doubtful —sufficiently rigid to admit removal from the cavity without distortion. Such waxes are a delusion and a snare.

The broad underlying principle in all wax pattern making for cast gold inlays is that the pattern wax shall be condensed, without stretching, into the cavity; and if stretching does occur, it must be neutralized prior to removing the finished pattern from the tooth cavity.

Simple cavities are easily managed. A piece of pattern wax of appropriate size and shape is warmed slightly over an open flame. The part representing the cavity is dipped into melted wax and immediately transferred to the moist cavity and pressed into position; the teeth are occluded, and the wax is carved and polished to represent an anatomic restoration, the finished casting.

As complications in cavities arise, it becomes necessary to meet them by various means or modifications in technic. A matrix may be indicated in some cavities and in others the wax tray method will be found superior. Generally speaking, I favor the wax tray method for the majority of cavities as it seems to me to be not only the most simple but also the most scientific procedure extant. For those reasons, I wish to dwell especially on the wax tray method and liquid wax process, believing that mastery of this rather simple technic will result in better fitting inlays, as well as adding to the serenity of the operator as to the relative perfection of the marginal adaptation of the subsequent casting.

WAX TRAY—LIQUID WAX

A piece of nonplastic pattern wax of sufficient size to give ample surplus is warmed throughout so that it may readily be pressed into the cavity and molded over the margins; the teeth are occluded, and the rough surplus only is carved away. No special attention need be paid as to whether or not this wax is stretched or bent during this first operation; for, after any undesirable surplus is cut away, the mass is removed from the tooth

cavity and placed in a water bath at a temperature of 125 to 130 F. (modified to meet wax characteristics), which neutralizes any induced elasticity. It is then cooled, and washed in alcohol, if necessary, to remove blood, etc., and we now have what I have characterized a wax tray—a more or less perfect impression of the tooth cavity and immediate surrounding tooth tissue, together with the "bite" and contact surface of the approximating tooth recorded. The wax tray is examined as to its marginal perfection, the entire cavity surface is coated with melted wax and the whole is immediately returned to the moist cavity and forced to position. The teeth are occluded, and the wax is carved and polished in the usual manner, the wax tray with its liquid wax coating thus becoming the finished wax pattern.

Let us consider several superior features of the wax tray method: We eliminate the elastic property in stretched wax; complicated cavities are rather easily managed, and, most important of all, the resultant pattern is, seemingly, the most nearly perfect replica that can be made. Let us consider briefly the physical properties of pattern wax and the conditions under which it is manipulated in the tooth cavity in the mouth.

Pattern wax expands or contracts under varying thermal influence; tooth cavity temperature is relatively fixed (95 F.); room temperature, let us assume for illustrative purposes, is 28 C. (82.4 F.); and let us again assume that the wax we are using ceases to flow, under the pressure used to force it into the cavity, at 40 C. (104 F.). The wax under consideration has an expansion or contraction of approximately 0.2 per cent for each rise or fall of 5 C. (9 F.). Hence, we have a theoretical discrepancy in the pattern of 0.2 per cent due to that percentage of shrinkage between 104 F., the temperature at which the wax ceases to flow, and 95 F., the temperature of the wax when being fitted in the cavity; it, of course, being understood that wax cannot be added where most needed—the cervical margin—with the pattern in position in the tooth cavity in the mouth.

With the wax tray method, we establish a tendency to reverse the behavior of the wax. Again assuming the wax tray is at 82.4 F., room temperature, it is quickly coated, on the cavity surface, with the melted wax and immediately forced into the cavity, which is at 95 F. As you will see, the tendency of this wax mass is to expand rather than contract; this being more especially pronounced if the wax tray is chilled to 60 or 70 F., which, naturally, is a more likely temperature.

After the finished pattern is removed from the cavity, the next step, prior to investing, is the preparation of its cavity surface. Except for the cervical aspect, the entire cavity surface of the pattern should be reduced by scraping or carving to within a millimeter or two from the margins, which reduces the bearing surface and incidentally makes room for a strong layer of cement. I believe that it is next to impossible, generally speaking, to make the interior (dentin) surface of the cavity in the tooth in the mouth sufficiently (mechanically) smooth and even to admit of a well-fitting inlay's being seated when consideration is given the fact that castings do not come from the mold with the same surface smoothness, and characteristics, as the wax, the main reasons being that in casting into a hot mold (and hot mold casting is considered the only scientific procedure) in an investing material of proper formula and suitable ingredients, the investment is more porous and the gold not only tends

to enter those pores, but also casts into and around all minute areas of roughness or unevenness. It should be clearly understood that this minute invisible cavity surface roughness or unevenness does not prevent the withdrawal of the wax pattern from the cavity; nor does it contemplate nodules on the casting, which result from air being trapped when coating the pattern, and which are readily observed under ordinary magnification by "binocular loupes," or other simple devices, which should always be employed to examine both the wax pattern and the casting.

TWENTY-FOUR-CARAT VS. ALLOYED GOLD

Having secured a relatively perfect wax pattern, we come to a consideration of 24-carat vs. alloyed gold.

There seems to be a disposition on the part of some to discredit 24-carat cast gold inlays on the ground that pure gold lacks sufficient strength or resistance to withstand normal occlusal force. From an experience extending over a period of more than a quarter century, dealing with all classes of cavities and conditions, I am strongly of the opinion not only that 24-carat gold, as an inlay material in perhaps at least 90 per cent of cavities, is adequate in tensile strength, elongation and Brinell hardness to withstand normal masticatory stress, but also that its inherent qualities add materially to the life and comfort of bicuspid and molar teeth so restored—provided the cavities in said teeth are properly formed, and the castings go accurately to place. Advertently, I am not discussing either the "slice" or the "saucer" preparation or formation of some of our impression and model advocates, who hang an overlay (not inlay) on the side of a tooth by a flimsy occlusal extension; nor do I wish to imply that I favor 24-carat gold where superstress is encountered and mass-flow is inevitable.

When tooth restorations are discussed, mature thought should be given to the maximum in life and functional efficiency that the restoration in question will impart to the teeth under consideration. Cast gold inlays may fail from two principal inherent defects or causes: (1) recurrent caries, and (2) induced occlusal trauma, the caries resulting from faulty marginal adaptation or continuity between inlay and tooth, and the trauma caused by a gold alloy which is too hard to yield to the enamel of occluding teeth.

Marginal discrepancies are caused largely by castings which do not go accurately to place, either by reason of being too small relatively or, if of relatively the same marginal dimensions as was the wax pattern when in the tooth cavity, by being held in suspension by the previously mentioned roughness or what-not on the cavity surface of the casting. If, then, the casting is of hard gold alloy, it cannot be malleted to place without fracturing the tooth; whereas 24-carat gold, being soft, will yield quite readily to minute roughness and unevenness when distributed over the narrow marginal area as previously described; and, by virtue of this same inherent quality, will, at the points of overcontact occlusally, give way to the enamel of occluding cusps without inducing trauma. A further consideration is that 24-carat gold is not unbalanced by repeated fusing, nor, with reasonable care, is it readily susceptible to contamination.

In recommending 24-carat gold for inlay purposes generally, in molar and bicuspid teeth, the idea is not advanced as a means to encourage carelessness or to evade needless faults in technic, but rather as an aid to the best technic that it may be possible to develop. Dr. Tag-

gart was, I believe, the first to advocate 24-carat gold for cast inlays. I look on that advocacy as one of his most valuable contributions, and that statement contemplates the fact that he has done more than any man in the way of refining and simplifying the mechanics of dental casting.

Dental restorations entail compromise. Science is "knowledge gained by systematic observation, experiment and reasoning." Dental inlay casting predicates complete knowledge of the materials entering the process and their behavior under the conditions necessarily imposed; or, as Dr. Souder expresses it, "The problem is not solved until each element or process entering the cycle of operations is specified in its effect on the finished casting"—and, I add, the tooth.

We had but few exact data relative to the intricacies in behavior of pattern wax and investing material prior to the dental research of the Bureau of Standards in cooperation with the Weinstein Research Laboratories. Inadvertently, Mr. Weinstein did for the dental profession what we had failed in doing for ourselves, viz., associating a wonderfully equipped neutral research laboratory with the work of solving our technical problems. I feel that Mr. Weinstein has rendered a distinct service to dentistry in cooperating with the National Bureau of Standards, which is probably the foremost institution of its kind in the world today.

All research to date indicates rather conclusively that the principles involved in the expanded pattern technic, as originally promulgated, are sound and the procedure is logical. The Bureau's research reports seem fully to justify that statement, and further to corroborate my meager findings relative to the necessity for utilizing intelligently the physical properties of the materials entering the process if we may hope to produce accuracy in the marginal adaptation and continuity of our inlay castings with the tooth cavity margins.

Since, then, all dental casting processes —no difference by whom originated, promulgated, modified, or advocated—must take full cognizance and advantage of the cycle of physical change of all the materials entering the entire process, what definite information is most needed in order to establish relative perfection in cast gold restorations?

As I see it, the data most needed by the profession, and which the Bureau of Standards is fully equipped and ideally situated to furnish, are, briefly, as follows:

PATTERN WAX

1. Irrefutable information and data on the exact behavior of manipulated pattern wax throughout the temperature range, especially at temperatures above 95 F. (35 C.).

2. The maximum effective wax expansion attainable without distortion.

3. The difference in the behavior of condensed wax and of cast wax.

4. The temperature at which the wax ceases to flow, or to be adaptable, by pressure, to the cavity.

5. The pattern technic best suited to meet the various cavity conditions encountered.

6. The best methods for releasing induced elasticity.

7. The most effective method for eliminating the wax from the mold.

INVESTMENT

1. Irrefutable information and data on the exact behavior of investments throughout the temperature range.

2. The most effective investment temperature at which to cast.

3. Crushing strength at various temperatures.

4. Porosity at varying temperatures and its effect on the casting.

5. Comparative ultimate efficiency of single and double investing technic.

6. Formulas and most suitable kind of plaster of Paris, and kind and grade of filler.

7. Effect of varying percentage, by weight, of water used in mixing, and various methods for mixing.

8. Effect of size, shape and position of the ingate in relation to the shape of the mold, and proper length of the ingate, i. e., distance from the bottom of the crucible to the mold; also the proper distance from the bottom of the mold to the bottom surface of the investment.

9. Most effective amount and character of casting pressure or force.

The point I wish here to stress is this: The accompanying instructions for the manipulation of present available pattern waxes and investing compounds contain no information or data relative to either their composition or their physical behavior when utilized for the purpose for which they are designed, though it is a significant fact that the use of different pattern waxes and investing materials may, and frequently does, produce varying results under relatively identical manipulative procedure and conditions. As a rather crude but nevertheless concrete example of this important fact, compare the two H-shaped castings which were made under identical conditions, but with different kinds or brands of investing material. Observe that one of the castings is much nicer in appearance, smoother as to surface and looks cleaner and sharper—more artistic, if you please, but that it cannot be seated in the cavity and is easily rocked or teetered by light alternate pressure on the ends; whereas, the other casting, while not so artistic, is seated in the cavity, is not susceptible to any rocking movement and is far superior in marginal adaptation and continuity.

Why this wide difference in two castings made under identical conditions—the same wax, the same temperatures throughout, the same gold? Simply this: There is a difference in the expansion of the investments under the same thermal influence; and that variation in expansion is due, I suspect, largely, possibly entirely, to the plaster content in these two investments.

The reason for stating it in that way is this: The first casting described (the one which does not fit) was made in a popular proprietary investing material, compounded for inlay, etc., casting purposes, and will, it is stated on the package, "expand without disintegration at high temperatures, and *produces exceptionally smooth castings.*" No information is given relative to formula or to inherent characteristics of ingredients, stress being laid on results—"perfect castings of exceptional smoothness." Parenthetically, we might here state that from the inception, both the profession and investment manufacturers have gone to extremes in an endeavor to produce castings of exceptional smoothness; when, in reality, castings, with mere art as the desideratum, are the easiest and simplest to make and least exacting in knowledge, skill, technic, materials and appliances. The other casting (the one that fits) was made in an investment of which I have both the formula and a comprehensive knowledge of the inherent characteristics of the ingredients. These data, coupled with our understanding of what varying quantity, quality, etc., of plaster of Paris does to our investments, are the basis for the forego-

ing opinion and one reason why we have been so persistent in emphasizing the importance of complete knowledge of all materials entering the entire cycle of operations.

There are many things, other than high or low plaster content in investments, which have an effect, good or bad, on the subsequent casting. It may seem to you that I am endeavoring to complicate the process beyond the reach of the average practitioner, which is emphatically not a fact; the bald truth being that through efficient appliances, definite data and reliable information, as previously outlined, the casting process becomes so amenable and the steps in technic so definite that, outside the necessary work in the mouth and the preparation of the pattern prior to investing, the entire process can be executed by any office assistant of average ability, and the resultant casting will be just as nearly perfect in every particular as though made by the most expert technician.

The predominant thought which I wish to leave with you is that dimensional perfection in dental casting is decidedly more dependent on definite knowledge than on acquired skill. When the profession becomes fully alive to and intimately acquainted with that fundamental truth, our literature on casting will not be characterized by a plethora of descriptive magic of the "read more and learn less" type; clinicians who have been extolling "some special wax, plaster or accelerator, oven, flux, or special gold alloy" in conjunction with their "special technic and who give no reason or proof to justify their claims," will discover that a "gold brick" has lost its mystic charm. Interest will then center on formulas rather than on name or brand of materials, and they, together with technic and appliance, will be coordinate. Clinic clubs, and clinicians and teachers generally, will then discuss the exact shrinkage value for the gold alloy in question, and the expansion curves for the wax and investment will be the foundation for demonstrations and teaching

CONCLUSION

I wish to reiterate the main object of this paper by again quoting from one of our real benefactors, Dr. Souder: "I am pleading for a familiarity with the laws governing dental materials, for honesty and completeness in the interpretation and display for experimental work, for technics based on accurate data and a selection of materials yielding the most in the scope of desirable qualities." Consummation and facility in application imply ethical cooperation within the profession and with and by the dental manufacturer.

DISCUSSION

Wilmer Souder, Washington, D. C.: You are now contributing to the work which the American Dental Association is doing at the Bureau of Standards. Last year, each member contributed 10 cents toward this research. I think the contribution will be 12½ cents this year, and I hope it will be 25 cents next year. We have had special waxes, special investments and special golds. Now we add to that a special method of getting the wax out of the mold. If you do that, I think you will be up-to-date on the many "certain" ways to produce perfect inlays. It is not necessary to discuss the question which arises between our work and that of Dr. Van Horn, namely, that you may or may not be able to chill a wax in the tooth cavity. We did chill the wax on the steel mold that we were using. There are some people who feel that you can chill the wax in the tooth cavity to a certain extent and have it under pressure and have the wax fit the tooth at a lower temperature. Dr. Van Horn and I have discussed a point that not more than one man in ten is concerned with. Now the more general phenomenon, shrinkage of gold, has always been with us. I believe that it always will be with us. Something must be done if you are going to com-

pensate for that shrinkage. First, fit the wax at some temperature. Then expand it a definite amount. You have then an invested pattern which is too large. When you burn out the wax, the cavity is too large. If you made an exact casting in that cavity and tried to fit it on the tooth, it would be too large. Dental alloys do not cast to the exact dimensions of the cavity. They universally show shrinkage. You cannot get enough enlargement of the waxes to take care of all the shrinkage of the gold. Fortunately, some investments will expand when heated. Some of them increase in dimensions up to a red heat. At the present time, you must divide the compensation for shrinkage. Part of it must be taken by the wax and part of it by the investment. The man who produces an investment or wax that will take care of all the shrinkage will have eliminated 50 per cent of the technicalities in making inlays. They are not difficulties, exactly, but they are technical operations that must be recognized at the present time. I know of no wax and no investment that will handle that. You must do something to take care of the contraction of the gold; how you do it is a matter of detail and convenience. I wish to read a part of a paper which was read in Chicago in March, dealing with the "Discovery of Expanded Pattern Technic": "In order that there may be no misunderstanding or conclusion that I claim credit for the original technic of casting to dimension by the expanded pattern technic, I wish to quote from Van Horn *(Dental Cosmos,* Vol. 52, 1910, page 877), where he describes a method of casting which gives a result larger than the original wax pattern: 'The investment was mixed with water at 120 F. The flask was heated in the machine so that when the investment was poured in the flask, the latter was very uncomfortably hot to handle with the finger. The flask was at no time permitted to cook, but kept in a constantly increasing temperature until the cast was made, at which time it was at full red heat.' From this experiment, he secured a net expansion of 1 per cent from pattern to casting. This reference also contains a quotation from Dr. Lane *(Dental Digest,* July, 1909, page 498) in which he establishes the importance of casting into hot flasks when shrinkage of gold is to be reduced or partially compensated. In 1911 *(Dental Cosmos,* Vol. 53, page 113), Van Horn added a further modification for accuracy in casting by investing with a slow setting investment and placing the flask in a water bath at 110 F., and as he states, 'The flask with its invested pattern is to remain in the water bath—no water coming in contact with the investment—without any change in temperature until the investment has thoroughly hardened, which takes about one-half hour'." That technic is being revived, apparently, by those who have not yet discovered this article, which is 18 or 20 years old. It does us no harm to give credit where credit belongs. I am pleased to include this in a part of the discussion, giving these two methods of *(a)* using hot water to mix the investment and *(b)* mixing the investment and putting in some kind of bath which will bring it up and expand the pattern before the plaster has set. The question of the use of 24-carat gold, I shall have to dodge, just as I did the question of chilling wax in the cavity. We do not include gold so soft as that in specifications for inlay golds. That is a question which you must decide. Dr. Van Horn has decided it to his satisfaction. Each of you must decide whether the soft, 24-carat gold will flow under the stress of mastication and move up, down, around or out of the cavity, as the rivet moves when you continue tapping it with the hammer. Dr. Van Horn has said correctly that we at the Bureau are not qualified dental technicians or professional men. We do not hold degrees in dentistry. We do have valuable cooperation from members of the profession. Cast inlays of 24-carat gold have a hardness of about 30 (Brinell). That is a relative value. A piece of hardened steel would have a value of about 200; 22-carat gold will have a hardness around 40. A hammered gold foil, 24-carat gold, will have a hardness around 50 or 60, if it is well condensed into the cavity. Your cast inlay 24-carat will be softer than the hammered gold-foil filling. It is for you to decide as to the 24-carat proposition. I cannot contribute anything more on that. The question which Dr. Van Horn has asked as to why those two inlays were different, one fitting the cavity and one not fitting it, I think is explained either by the types of investment used, or the temperature to which the investment was heated. He said that the same wax and same gold was used, but there are investments which, when heated, will expand up to a red heat. Others will expand up to about

120 C., practically, the point at which you eliminate the water, and then contract. It is possible that Dr. Van Horn has used one of the contracting investments in the second case. You can select one which will do that. The investment manufacturers will soon be telling you which investments will expand constantly up to a red heat if you wish to carry them to the red heat. This application of scientific methods to materials is coming. We see indications of the manufacturers agreeing on this. It is a sound, fundamental basis and a thing to which they should tie. In fact, it is the only thing to which they can tie to protect themselves. The parasite manufacturer who has no research laboratory and no responsibility can think of just as descriptive and just as powerful adjectives as the legitimate manufacturer. He can send you just as attractive men and just as smooth talkers as the conscientious manufacturer, but he cannot send you accurate, verified data on dimensions. The manufacturers are beginning to realize this, and probably within the next year you will find manufacturers talking about definite physical properties and dimensional changes, giving you just what you want, and then your technics will be a simple question of architecture. You will really become architects and you will no longer be mechanics or experimenters. A number of questions have been asked about the behavior of the wax, part of which I can answer and part of which I cannot. The maximum temperature to which you can heat wax and have it maintain its general dimensions, you must determine for yourself. You can take a piece of wax that you are using and bend it around a mandrel, say a 1-inch mandrel, into a U or C shape at the temperature at which you are using the wax, and chill it in position; then put it in a tray of water and keep adding warm water or put a burner under the tray and watch the wax. The minute it starts to open or spread out, read the temperature. That is the limit for the wax which you are using. On most waxes at about 105 F., it will begin to open. That is the danger point. As to the best technic, I am afraid that we will never be able to decide that. We would like to give you all technics. The Bureau is not functioning properly unless it presents both sides of the question to show you the difficulties as well as the superiorities of the different technics. So we prefer to put data before you, to give you a book such as Research Paper No. 32, and let you decide. If you decide on something from the data presented in that book, do not call it the Bureau of Standards technic, it is *your* technic. One of the worst things that could happen to us would be for someone to go over the country saying, "I am giving the Bureau of Standards technic." We are not advocating any technic as being the only technic.

Dr. Van Horn (closing): As regards chilling the wax pattern when in the tooth cavity in the mouth: It would require elaborate preparation; it cannot be done by merely spraying with cold water. In some of my former papers, two special thermometers are shown which I had made to determine the temperature of the wax pattern in the tooth cavity. During that series, I tried to chill the wax by the ordinary methods. There may be a drop of two degrees Fahrenheit, or perhaps a drop of 5 degrees, but before we can get the pattern out of the cavity, the temperature is again 95 F. My experience indicates that it is neither practical nor essential to attempt to chill the pattern *in situ*. As for 24-carat gold, the day will come, and I think there are some researches going on now, which will probably change the attitude of mind of the dental profession regarding the use of this gold for cast inlays. I have been insisting on this for years. The original idea was Dr. Taggart's. He, as I told you, has done more than any man or group of men in refining and perfecting the mechanics of dental casting. There have been submitted to the Bureau of Standards two cast gold inlays which are approximately 24-carat gold. There may be a slight variation owing to picking up impurities through repeated fusing. One inlay had been in a tooth for twenty years. The other had been in for ten years and acted as the support for one end of a removable bridge—not a "movable removable" bridge. That bridge acted also as a splint. These inlays are now in the hands of the Bureau, and will be tested in all particulars. My contention has been that the physical data on 24-carat *fresh* cast gold does not necessarily apply to the 24-carat inlay that has been properly made and placed in the tooth cavity, because the physical characteristics of the gold are modified by manipulation prior and subsequently to its insertion in the cavity. If a cusp comes in contact with 24-carat gold, it hardens that

gold, which will not then have the same Brinnell hardness that fresh cast 24-carat gold has. If we take a 24-carat casting with riser and surplus attached, and bend the riser back and forth, we observe that it bends easily at the start, but if we keep on working it, the resistance increases. It is true as Dr. Souder says that the one investment of which I spoke, the one in which was made the casting which does not fit, had not the proper expansion, for both castings were handled with exactly the same technic. With my equipment, one does not have to guess at temperatures; we know what the temperatures are throughout the entire technic. As to testing the maximum expansion of pattern wax by bending a piece in a U-shape around a mandrel, chilling it in position, then immersing it in water and noting the temperature at which the ends of the U begin to open or spread, I do not know whether I followed Dr. Souder correctly as to that. I believe that maximum expansion of properly manipulated pattern wax cannot be determined in that manner. We do not bend, or stretch, wax around a cavity when doing inlay work, but condense it into the cavity. If, in this U-shaped pattern, the induced elasticity has not been released, I hold that the maximum temperature at which that particular wax dare be invested, and the consequent usable maximum expansion of the wax, has not been determined. I am inclined to think that maximum expansion in properly manipulated pattern wax is governed by its state of plasticity at given temperatures, and that any pattern wax may be safely expanded up to any temperature at which it will not distort or dull by reason of its plasticity. There are some investigations being made at the Bureau regarding pattern waxes and investing compounds. When this is to be published I do not know, but trust that it will contain accurate data on the behavior of condensed wax manipulated similarly to the wax tray method described in the paper. I spent a half-day at the Bureau in March and was shown everything. They have the most wonderful equipment imaginable. They have the men and, above all, their research work is cold-blooded: they do not look on you or me as an individual. They look on our work as the product of Mr. A or Dr. B. They are not interested in me nor in my technic; they are interested in getting at the truth. They have nothing to sell, and nothing to gain except giving the world the truth. I think if the dental profession, if our entire population, would look on the Bureau of Standards as *our* Bureau of Standards, it would be a wonderful thing; for it is *our* Bureau of Standards. We, as the taxpayers of the nation, are supporting it, and should cooperate in every way in the work that is being done. When you are conducted through the Bureau of Standards and see a machine that will measure one-millionth of an inch and another machine as big as a house, you begin to realize what the dental profession has been missing. We are behind the times. Commercial interests generally have taken advantage of the Bureau's resources. We, as an organized profession, have just recently come to a partial realization of the advantage of such service, and it is to be hoped that it will be continued and amplified. I wish again to thank Dr. Souder. I hope that our state society, which I believe was the first to encourage a Bureau of Standards research, will continue and, if necessary, make a personal canvass and a personal contribution to carry on the work that will be of such great benefit to our clientele.

PROGRESS REPORT ON RESEARCH ON DENTAL MATERIALS (II). THE RESEARCH PROGRAM*

By N. O. TAYLOR,† Ph. D., Washington, D.C.

A PROGRAM of cooperative research was inaugurated in April, 1928, by the National Bureau of Standards and the Scientific Foundation and Research Commission of the American Dental Association.

Under the agreement providing for this program, the Bureau of Standards furnishes laboratory facilities, permanent equipment and technical and clerical assistance. The personnel employed on the project have access to the extensive library facilities of the Bureau and have the exceptional privilege of consulting with the many experts on the Bureau staff interested in those specialized types of work which lend valuable assistance in the investigation of dental materials.

The American Dental Association, through the appropriations made by its Research Commission, provides for the salaries of the personnel stationed at the Bureau to carry on the work and for the purchase of materials used in the various investigations.

The Bureau of Standards has, prior to and since the inauguration of this Research Program, had two members of its staff working in the dental field. In addition to the services of these men, the Bureau has provided much in the way of consulting service and advice, which, coming from experts in their own particular fields, has been of exceptional value in directing and guiding the work along the proper lines and insures that the results are in harmony with the latest scientific and engineering standards.

The personnel maintained by the Association consisted in the beginning (1928) of one research associate, but was increased early in 1929 by the addition of two members of the American Dental Association to the staff. Those of us who have had the pleasure and privilege of being in this group feel that the Bureau, through the director, George K. Burgess, and every member of its staff has contributed in every possible way to make the project a success, and we hope that the American Dental Association will as an association take cognizance of and appreciate their efforts.

The research program as now formulated contemplates the investigation of properties of current materials, studies of the effectiveness of current technics and fundamental research in the following general divisions of the dental material field: (1) amalgam alloys, (2) casting golds and accessory materials, (3)

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*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 9, 1929.

†Research Associate for the American Dental Association, National Bureau of Standards.

wrought gold alloys, (4) vulcanites and vulcanite substitutes, (5) cements and (6) porcelain and synthetic porcelains. As item 7, it is proposed that specifications for the properties of acceptable dental materials be provided for the guidance of the profession as rapidly as a sufficient number of data are accumulated to warrant their publication.

The present status of the program may be summarized as follows:

1. In 1928 a survey of the physical and chemical properties of current amalgam alloys was carried out in connection with an investigation of the effectiveness of mechanical amalgamation.[1] Papers on these subjects were presented at the meeting of the Association held in Minneapolis in August, 1928, and later, with some additional data, at the Midwinter Clinic of the Chicago Dental Society.

A second survey of amalgam alloys has been completed in 1929. New data on tensile strength and hardness of this type of materials were obtained. The data from this survey will be discussed at this meeting in a paper, "A Specification for Dental Amalgams."

Members of the Bureau of Standards staff, in cooperation with the Army Dental School at Walter Reed Hospital, have been investigating the possibility of amalgam alloys being a source of mercurial poisoning. The details of this study are given by the Bureau of Standards and Walter Reed Hospital in a separate paper, "Mercury Vapor from Dental Amalgams."

A report of the local committee of the American Dental Association which has cooperated with us in the study of amalgam alloys is being presented as a clinical demonstration later in the week.

2. A tentative agreement has been formulated with the gold section of the American Dental Trade Association whereby members of this group will assist in a survey of the current casting golds by providing samples of casting golds for test from dealers' stocks, replacing the materials for the dealer and in turn receiving the resulting scrap materials at the conclusion of the tests. Work in this field is scheduled to begin within the next few months.

Data on the physical properties of impression compounds, together with suggested minimum requirements for this type of material, will be found in a paper, also being presented at this meeting, entitled, "Variables in the Cast Denture Process."

Preliminary tests have been made on impression plasters, and the data accumulated are given in the paper just mentioned.

This paper will not be published until further work now in progress in this field is completed. A brief outline of the oral presentation follows.

The variables in the cast denture process are: (1) dimensional changes in impression compounds; (2) setting changes in impression plasters; (3) setting changes in casts or models made of artificial stone; (4) setting and thermal changes of investments, and (5) shrinkage of gold in casting.

These variables are similar to those found in the inlay casting process and, by virtue of the greater dimensions or lengths of partial restorations, produce total inaccuracies many times as great as those in the inlay technic.

Tests were made to determine the dimensional accuracy of impressions made of compound, plaster or combinations of

1. Taylor, N. O.: A Survey of Amalgam Alloys, J. A. D. A., 16:590 (April) 1929; Mechanical Amalgamation, ibid., 16:583 (April) 1929.

compound with plaster and surgical paraffin. Comparisons were made of the dimensions of various types of stone, investment and fusible metal models and those of the original which they were to represent. Dimensional variations in castings made by a variety of technics were measured and various methods used in attempting to obtain castings which would fit accurately upon the dies from which the original impressions were taken. The data secured may be briefly summarized as follows:

1. Impressions taken in impression compound were found to exhibit shrinkage in all internal measurements and showed marked evidence of warpage and distortion caused by the compound's drawing back, more or less irregularly, into the tray. Chilling the tray in the mouth increased this warpage. Use of compound at as low temperatures as it can be forced to position in the mouth decreased the warpage and shrinkage slightly.

2. Plaster impressions were slightly larger than the model, particularly in external dimensions.

3. Impression compound with either a plaster or a wax wash showed increased accuracy over impressions taken with compound or plaster alone.

4. Castings made by ordinary denture casting methods are smaller than the object they are to fit.

5. Castings can be made to fit accurately by *(a)* pouring a metal model in a plaster impression; *(b)* taking a second impression and pouring a second model of a first quality high heat investment; *(c)* regulating the casting temperature to give the desired accuracy of dimension.

Representative members of the dental profession are now cooperating in this research by making practical tests of these principles, and the results of their findings will be incorporated in the paper when it appears in final form.

A specification for investment has been developed by members of the Bureau of Standards staff in response to a request from the War Department. This is also being presented by the Bureau at this meeting.

Further data on investments will be found in both the paper previously mentioned on "Variables in the Cast Denture Process," and in another, "Current Inlay Technics," also being presented at this time. These papers have been prepared with a view to clarifying some of the confusing situations which have arisen in the casting fields owing to the multiplicity of conflicting "technics."

A large number of both new and commercial inlay waxes are now available and will shortly be distributed to well-known inlay workers for practical tests. Laboratory tests of the same materials will be carried out simultaneously.

Many problems in the investigation of wrought golds, vulcanites, condensation products, cements, synthetics and porcelain have been suggested. Local committees have been appointed to assist in the studies, but work has not started in these fields because of the insufficient personnel available or, fundamentally, to the lack of sufficient appropriation to enter these fields at the present. (The Dental Association appropriation for the research program was $5,000 in 1927-1928 or about 15 cents per member. This was increased to $7,500 for 1928-1929.)

7. The plan outlined for the development of specifications for dental materials contemplated the following factors as important means to the desired end:

(a) The dental profession should state the practical requirements of satisfactory materials for every dental use. In the absence of detailed data on the physical

properties of dental materials, the designation of materials by trade name as satisfactory or unsatisfactory appears advisable.

(*b*) The manufacturers of dental materials should assist in setting practical standards.

(*c*) Surveys and tests of materials in particular fields, often carried out in connection with other problems, should be the contribution of the research workers.

(*d*) The final formulation of the specifications for presentation to the manufacturers, dealers and the dental profession should also be carried out by research workers.

This plan, as carried out to date, has included the sending of questionnaires to representative members of the dental profession, asking them to designate materials found satisfactory in the amalgam alloy, casting gold and accessory fields. The response was very gratifying, and the data secured have served as a basis in the selection of several types of materials for test purposes.

Questionnaires of a more detailed nature were sent to many manufacturers of dental materials. The returns from this group, which were far more varied than those mentioned above, indicated that many manufacturers were in need of scientific information about their own products. Aside from the great practical value of several of the replies, the net returns seem to have divided the manufacturers into several well-defined groups, as follows:

(*a*) Those manufacturers who are interested in the production and sale of first-class materials and who are willing to assist in every way in the development of standards for dental materials. These manufacturers have contributed information on details of manufacture, given formulas, made practical suggestions and, in general, have been of great assistance. It is interesting to note that the manufacturers who have seen the most of the research work are the strongest advocates of dental standards.

(*b*) A group who have completely ignored all correspondence. This group includes the majority of the manufacturers of low-grade materials. The quality of their products is such that any reasonable standard would surely exclude them, and their attitude seems to be to continue to make these substandard materials as long as their market continues or until such time as the members of the dental profession have reached a point where they will refuse to use materials not known to be of good quality.

(*c*) A group of manufacturers, some producing low-grade materials and others materials of good quality, who feel that the American Dental Association and the Bureau of Standards, acting for the various government agencies, are overstepping all bounds by proposing to establish standards in the dental material field. This group, which has varied from time to time, has seen fit to object strongly to the research program being carried on at all and are inclined to object to every point no matter how inconsequential when it is brought up as part of a possible specification.

(*d*) Those manufacturers who are still on the fence. Members of this group seem undecided as to their policy in the matter of offering assistance to the program.

The following extracts from replies to questionnaires are presented without individual comment or explanation as illustrative of the varieties found in the responses obtained.

"We would be very glad, indeed, to cooperate with you in every way and trust that a movement will be brought about

whereby all the manufacturers, particularly the gold group, will also coordinate in this work."

"There have never been any specifications or standard tests set up for any of the dental materials that we manufacture and we are greatly pleased to know that you are working to that end."

"We want to cooperate with you in any way, shape or manner we can."

"We do not feel that we at the present time have enough data in hand to give definite figures as requested."

"We wish to advise that . . . we have this week made request for return of all our old alloy to us for exchange. . . . "

"We are apathetic regarding this matter."

"From no angle can the practical making of amalgam fillings be considered scientific, nor can they be made so."

"Your specifications for dental amalgam alloys are superfluous."

"I am in hearty accord with the purpose of the A. D. A. in their effort to establish an acceptable standard of essential physical properties in our dental alloys."

"For the present, we are not in a position to do anything in the matter."

"We have a reply from our parent company . . . today in which they reluctantly state that they prefer not to give out the physical properties of their modeling composition."

"We are glad to cooperate with the research now in progress and we believe that much will be accomplish which will be beneficial to the dentist, the patient and the manufacturer of dental supplies."

The following statement forwarded by a manufacturer of an amalgam alloy found to be unsatisfactory seems to illustrate the attitude of some manufacturers and warrants some discussion:

"My company has the legal and moral right to supply the demands of trade with respect to the various types of alloys that will fit the requirements of their practice."

This statement is an attempt to justify the sale of a badly shrinking amalgam alloy. It is included as part of a protest against the reporting of properties of materials together with their trade names. We feel that the statement is probably true but also feel that the Research Commission of the American Dental Association is justified in establishing standards for satisfactory materials and in imparting any available data to the dental profession as a means to an end—"better dentistry." It is hoped that the profession, once informed, will find that certain types of material do not meet any requirement of their practice and that the manufacturers will be relieved of the "legal and moral" necessity of supplying substandard materials.

The laboratory tests of materials have been completed in the case of the amalgam alloys and a tentative specification based on the available data approved by the executive board of the Research Commission of the American Dental Association. This specification is being presented as a separate paper at this meeting, together with the data considered in its formulation.

Suggested requirements for impression compounds have been drawn up as previously mentioned, as has a new tentative United States Government specification for investments.

Specifications for other dental materials will follow as data are available, inlay wax, impression plaster and casting golds being in the group that will next be considered.

TENTATIVE SPECIFICATIONS FOR DENTAL CASTING INVESTMENT*

By WILMER SOUDER† and WILLIAM T. SWEENEY,‡ Washington, D. C.

THE increased accuracy with which dental castings can now be produced makes necessary selection of accessory materials of definite physical properties.

The dental investments offered the profession today show a wide range of dimensional changes when subjected to the treatments encountered in the dental laboratory. There are also differences in strength, time of setting, fineness and general suitability for use in dental work. The careful operator will appreciate definite information on this material. Unfortunately, he is not being given this information by all makers of investments.

The specification offered herewith was prepared at the request of the War Department and is offered for the consideration of those dental school and research laboratories conducting experiments or tests on dental materials having in mind the selection of the best materials.

The requirements proposed are not excessively rigid, but are regarded as the minimum for use in casting operations. The tests, necessary to insure compliance with the specification, are not difficult to perform. A sufficient number of data or references to standard methods are given to enable testing laboratories to perform the tests specified.

The effort to compensate, as far as is possible, for the shrinkage of gold alloys justifies the length requirements. Reasons for the strength requirement, fineness limits and general requirements are evident from a study of the object in mind; viz., the production of a satisfactory casting, to dimension, and without roughness or visible defects.

It is believed that manufacturers will supply a definite need when they uniformly furnish to the profession exact values for the items mentioned in this specification. Certainly, members of the profession will be able to eliminate one more of the uncertainties and variables in their work if they select an investment of known properties.

The following specification is offered as the best list of values available at this date. Improvements are expected in materials and should be matched by increased limits in the specification. Dental schools following the plan for laboratory experiments outlined in a recent article[1] will be able to follow these developments

*Publication approved by the director of the Bureau of Standards of the U. S. Department of Commerce.

*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 9, 1929.

†Principal Scientist, National Bureau of Standards.

‡Junior Scientist, National Bureau of Standards.

1. Souder, Wilmer: Physical Properties of Dental Materials (Some Laboratory Experiments for the Dental School), J.A.D.A., 16: 1829 (Oct.) 1929.

and to make definite advances in the requirements as improvements are evolved in investments and should do so for the benefit of their students and as an encouragement to the manufacturers who sponsor the development of better products.

PROPOSED TENTATIVE SPECIFICATION FOR DENTAL CASTING INVESTMENT

I. General Specification: This material shall be a powder composed essentially of plaster of Paris, silica, or other refractories and chemicals which, when mixed with water in proper ratio, applied to the dental wax pattern and heated in the usual manner, will be found satisfactory for use in casting dental restorations.

II. Types: Only one type of material is required. Time of setting may be modified to suit the needs of the operator and section V5 should be changed when necessary to meet this special need.

III. Material: The material shall be uniform and free of foreign material, partly set or caked lumps. Coloring material as such will not be regarded as foreign material.

IV. General Requirements: 1. The material shall not crack in heating. 2. The material shall not contaminate the alloy cast into it and shall not cause pitting or roughness of surfaces on the alloy. 3. When heated, the material shall not give off poisonous or offensive odors.

V. Detail Requirements: 1. The setting expansion shall be 0.05 per cent or over at the end of twenty-four hours. 2. The thermal expansion shall be 0.6 per cent or over when heated from room temperature to 700 C. 3. During the preceding test (V2) the specimen shall not at any temperature above 200 C. show a length shorter than the original length at room temperature, and shall not at any higher temperature show a shrinkage or decrease in length of more than 0.15 per cent of the maximum length at any lower temperature. 4. The compressive strength shall be 350 pounds per square inch or over. 5. The time of setting shall be not less than fifteen nor more than thirty minutes. (See paragraph II for modification in time of setting.) 6. Ninety-five percent shall pass a No. 100 sieve, and 100 per cent shall pass a No. 30 sieve.

VI. Methods of Inspection and Tests: 1. Sampling. Ten pounds of material taken at random shall be submitted for test. The material, if taken from original packages, shall be submitted in moisture-proof containers bearing the name of the manufacturer.

2. Testing consistency. The investment used in making all test samples will be mixed with sufficient water to produce a mix of "testing consistency" in accordance with the following directions to give a "slump" within the following limits: Hand mixes will be spatulated thirty seconds, mechanical mixes fifteen seconds. A cylindrical mold 2 inches long with an internal diameter of 1⅜ inches will be placed on a glass plate and filled. Two minutes from the time of starting the mix, the mold will be lifted and the mixture allowed to slump or spread over the plate. The average of the maximum and minimum diameters of spread of the slumped mixture shall come between the limits of 2¼ and 3 inches. These measurements will be made one minute after the cylinder is lifted.

3. Setting expansion. The change in dimension on setting will be determined on a 30-cm. specimen by observing the change with a micrometer microscope comparator or equipment of equal accuracy.[2]

4. Thermal Expansion. The thermal expansion will be measured on a specimen (1.2 cm. in diameter by 20 cm. long, approximately) by the "fused quartz expansion apparatus" method, or by the use of equipment of equal accuracy. This test shall be completed in three hours or less.[3]

5. Time of Setting. Two hundred grams of the sample will be mixed with enough water to make a paste of "testing consistency" (See VI2) and tested with a vicat needle. Setting is considered complete when the needle no longer penetrates to the bottom of the specimen.[4]

6. Fineness. Fineness will be determined by screening 100 gm. of the dried sample through

2. Coleman, R. L.: Dent. Cosmos, 68:746 (Aug.) 1926. Bureau of Standards Research Paper No. 32, December, 1928; price, 35 cents, Supt. of Documents, U. S. Government Printing Office.

3. Hidnert, P., and Sweeney, W. T.: Bureau of Standards Research Paper No. 29, November, 1928; price, 10 cents; Supt. of Documents, U. S. Government Printing Office.

4. A.S.T.M. Standards, Part II, page 32, 1927, or U. S. Government Master Specification No. 248.

the sieves specified, and determining the amount of material remaining on each sieve. The material will be shaken through the sieve with as little abrasion as possible.

7. Compressive strength. Two thousand grams of the sample will be mixed with enough water to make a paste of "testing consistency" and poured into five cylindrical molds, 2 inches in diameter by 4 inches high, the containing vessel being moved back and forth over the mold during pouring. The sample will be worked slightly to remove air bubbles and struck off level. The cylinders will be removed from the molds as soon as they are hard enough to handle, and stored in air at a temperature between 60 and 100 F. Tests will be made after seven days.

In computing the average strength, any cylinder whose strength varies more than 15 per cent from the average will be discarded. In case three or more cylinders vary more than 15 per cent from the average, the lot will be discarded and the test repeated.

SUMMARY

1. For setting expansion (24 hours), the minimum is 0.05 per cent.

2. For thermal expansion (700 C.), the minimum is 0.6 per cent.

3. There must be no shrinkage from heating (0.15 per cent reversal permitted).

4. The compressive strength, minimum, shall be 350 pounds to the square inch.

5. Time of setting (as specified or) shall be from fifteen to thirty minutes.

6. As regards fineness, 95 per cent shall pass a No. 100 sieve; 100 per cent shall pass a No. 30 sieve.

7. All general features must be satisfactory.

RELATION OF DIET TO THE SKELETAL DEVELOPMENT OF SWINE, INCLUDING THE DEVELOPMENT OF TEETH*

By HENRY KLEIN and E. V. McCOLLUM, Baltimore, Md., and S. S. BUCKLEY and PAUL E. HOWE, Washington, D. C.

THAT the quality of the diet is an important factor in determining the structural characteristics of the teeth and bones of animals has been reported by a number of workers. A detailed review of the subject will not be attempted. May Mellanby[1] has recently reviewed the literature in some detail.

Well controlled investigations of the relation of diet to dentition, and to the incidence of dental defects, are small in number as indicated by an analysis of the dental literature.[2] In experiments dealing with this subject, the dog, guinea-pig and rat have been used heretofore as the experimental animals. Whether or not such animals are comparable to human beings in their reactions to dietary changes and deficiencies,

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*From the Department of Chemical Hygiene, School of Hygiene and Public Health, the Johns Hopkins University, Baltimore, Md., and the Animal Husbandry Division, Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C.

1. Mellanby, May: Physiol. Rev., 8:545 (Oct.) 1928.

2. Klein, Henry: J. Dent. Res., 9:5 (Feb.) 1929.

especially in relation to the incidence of dental defects, is somewhat problematic. It was thought that the use of a larger animal, such as the pig, would throw more light on this subject.

It is quite well established that the composition of the diet with respect to calcium and phosphorus is of the utmost importance for normal growth and ossification. Thus, McCollum and coworkers[3] have produced rickets in rats fed diets low in calcium and high in phosphorus. Shipley and others[4] produced a similar condition in rats upon high calcium, low phosphorus diets. When the level of phosphorus was raised so that the ratio of calcium and phosphorus was normal, rickets did not develop. They have shown that an optimum ratio of calcium and phosphorus in the diet is essential for normal growth of, and ossification in, the rat.

The fact that diets unbalanced in respect to calcium and phosphorus are able to affect ossification led McCollum and Grieves[5] to study the effects of such deficient diets on the tooth structure of rats. They have found that the percentage of oral defects is greatest in those rats fed diets deficient in protein, calcium, and vitamin A; and that rats on diets low in calcium exhibited the next highest incidence. Those diets low in both calcium and vitamin A produced the third greatest percentage of damage to tooth structure.

Similar observations on the relation of diet to dental development have been reported by Mellanby,[6] Wells,[7] Marshall,[8] Gies,[9] Perlzweig,[10] Bunting,[11] Toverud,[12] Orban[13] and others.[14]

Diets such as those used by the above mentioned workers may probably play an important rôle in determining the structural and developmental characteristics of the teeth and bones of the larger mammals, including man. These investigators have been interested in an attempt to correlate poor diet with poor tooth structure, and since the results are agreed, their conclusions may be considered well-founded. No systematic efforts have as yet been made to investigate and isolate those periods, whichever they may be, in the development of the individual in which a poor diet would result in the most serious defects in tooth structure. Is prenatal more important than postnatal diet, or is the situation reversed? Or may a certain period of exposure to a deficient diet in the postnatal development be of the greatest significance? Many essayists[14] have been concerned with such or closely related

3. McCollum, E. V.; Simmonds, Nina; Parsons, H. T.; Shipley, P. G., and Park, E. A.: J. Biol. Chem., 45:333 (Jan.) 1921. McCollum, E. V.; and Simmonds, Nina; Shipley, P. G., and Park, E. A.: ibid., 47:507 (Aug.) 1921.

4. Shipley, P. G.; Park, E. A.; McCollum, E. V., and Simmonds, Nina: Bull. Johns Hopkins Hosp., 32:160 (May) 1921.

5. McCollum, E. V., and Grieves, C. J.: Gross Maxillary and Dental Defects in Three Hundred Rats on Defective and Deficient Diets, J.A.D.A., 9:467 (June) 1922.

6. Mellanby, May: Brit. J. Dent. Sc., 64: 70 (March) 1921.

7. Wells, F. M.: Brit. J. Dent. Sc., 64:135 (May 2) 1921.

8. Marshall, J. A.: Physiol. Rev., 4:564 (Oct.) 1924.

9. Gies, W. J.: Dominion Dent. J., 33:163 (May 15) 1921.

10. Perlzweig, W. A., and Gies, W. J.: Dent. Cosmos, 67:276 (March) 1915.

11. Bunting, R. W.: Prenatal Feeding with Special Reference to Bone and Tooth Development, J.A.D.A., 11:554 (June) 1924.

12. Toverud, Guttorm: Dent. Cosmos, 69: 1213 (Dec.) 1927.

13. Orban, Balint: Nutrition and Teeth, J.A.D.A., 14:1619 (Sept.) 1927.

14. Footnote 2, pp. 7-9 (bibliography).

discussions. Little experimental evidence is available on this point except isolated experiments on human beings by clinical men and practitioners.

These reports, few in number, are in most cases poorly controlled, and the number of individuals on whom observations were made have been too few to justify attempts to treat the data statistically. The results, therefore, cannot be interpreted as established facts, and so are of little value.

The present investigation has been undertaken in an attempt to answer some of the foregoing questions. Experimental animals whose environment may be rigidly controlled and kept constant have been used. Such control is exceedingly difficult with human beings.

A few words as to the special biologic value of the pig in connection with this study seem apropos. The domestic pig is a diphyodont, omnivorous mammal whose period of gestation and lactation approaches more closely that of the human being than any of the experimental animals used previously. (The lactation period in the pig extends over seventy days. The gestation period is 114 days.)

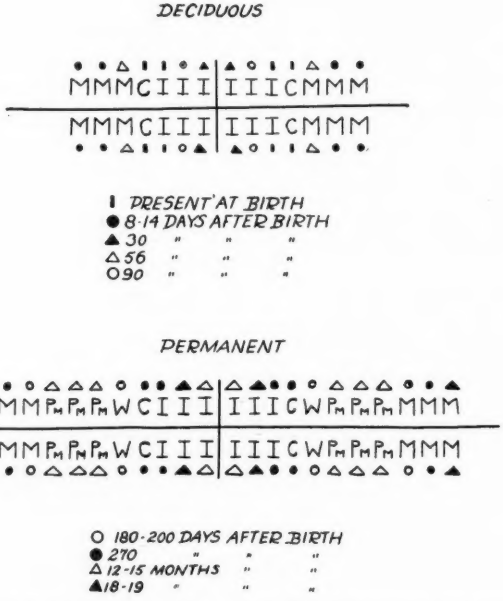

Fig. 1.—Position and dates of eruption of the teeth of the deciduous and permanent dentitions in the domestic pig.

The temporary dentition consists of twenty-eight teeth, namely, eight temporary molars, four wolf teeth, four cuspids and twelve incisors.

The full grown hog has forty-four permanent teeth, of which twenty-eight are preceded by the deciduous teeth. Sixteen appear as permanent teeth. The pig is born with eight teeth, which are one-

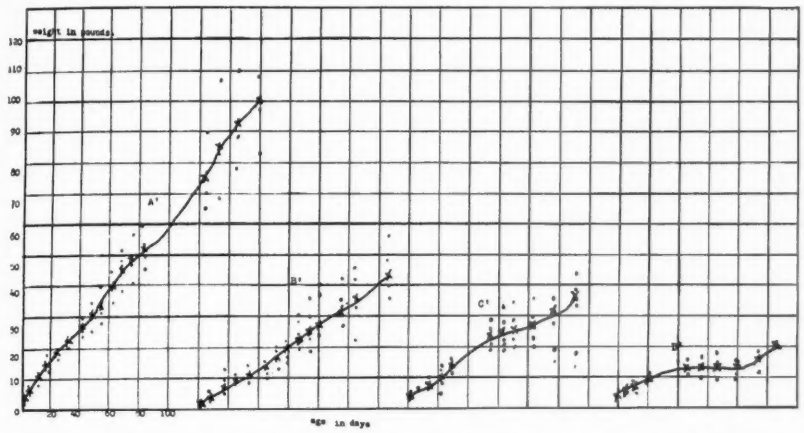

Fig. 2.—Effects on early growth of offspring from sows fed on diet 3 during gestation or lactation. *A'*, controls, 1928 offspring of sow 81 (growth curve average of four pigs). *B'*, on diet 3, 1928 offspring of sow 78 (growth curve average of five pigs; diet fed after weaning). *C'*, on diet 3, 1928 offspring of sow 72 (growth curve average of six pigs; diet fed at birth). *D'*, on diet 3, 1928 offspring of sow 75 (growth curve average of seven animals, the sow fed at one-half gestation period).

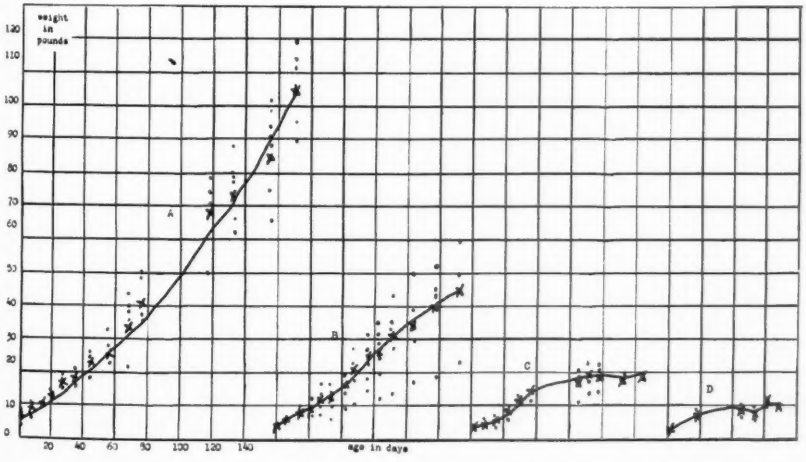

Fig. 3.—Effects on early growth of offspring from sows fed on diet 1 during gestation or lactation. *A*, controls, 1928 offspring of sow 74 (growth curve average of seven pigs). *B*, on diet 1, 1928 offspring of sow 78 (growth curve average of six pigs fed at weaning). *C*, on diet 1, 1928 offspring of sow 73 (growth curve average of twelve pigs fed at birth). *D*, on diet 1, 1928 offspring of sow 70 (growth curve average of six pigs, the sow fed at one-half gestation period).

quarter to three-eighths inch in height above the gums. Of these, the two foremost in each jaw are designated as corner incisors. The other four are the deciduous tusks or cuspids. The fully matured hog has four cuspids and twelve incisors. The incisors in each jaw are situated three on each side of the median plane. There are seven molars in each side of the upper and the lower jaw, which makes twenty-eight permanent molars. The last three molars, those farthest back in the mouth, are permanent and not preceded by deciduous teeth. The first molar, which appears just posterior to the cuspid, is sometimes called the wolf tooth and is at times considered a special tooth. It is a permanent tooth and often appears very small and defective. The permanent dentition has, in addition, four cuspid teeth or tusks, two in each jaw. These assume large proportions in the male and are employed as offensive weapons. Figure 1 describes diagrammatically the deciduous and permanent dentitions in the hog.

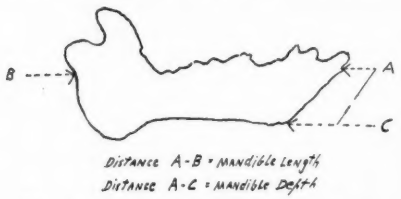

Fig. 4.—Location of mandibular measurements.

The deciduous dentition is complete at the end of the third month after birth. The teeth of the permanent dentition appear from the sixth to the nineteenth or twentieth month, at which time the permanent teeth are completely erupted.

GENERAL EXPERIMENTAL PROCEDURE

Twelve Poland China gilts were taken from pasture and bred in the spring of 1927. (Poland China hogs are black with light feet and white spots on the face and the tip of the tail. Gilts are young virgin females.) They were then returned to a common pasture where they were permitted unlimited choice of whatever vegetation was available, in addition to standard grain feeds. The sows and pigs were subsequently divided into groups after the sows had farrowed, and each group was placed on a different experimental diet. The details of the groupings and the diets fed each group are indicated in Table 1. The same sows were later bred for another series, and each animal placed at a subsequent date on the same diet which the respective litters had received the previous year.

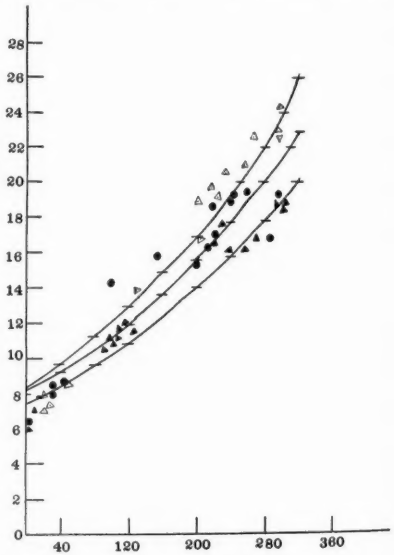

Fig. 5.—Curves showing the difference in rates of growth of mandible of animals from the three food groups as determined by measurements of mandibular length. Open triangle, controls; solid circle, animals on diet 1; solid triangle, animals on diet 3; dash, calculated values for mandible length.

The sows received the diets either during part of the gestation period, during the period of lactation or, in some cases, after weaning. The arrangement of the groups for 1928 also is shown in Table 1.

In both the 1927 and 1928 groupings, the offspring at weaning were fed on the experimental diets which their mothers had received until they died or were slaughtered. Those which died naturally between the ages of 1 and 304 days

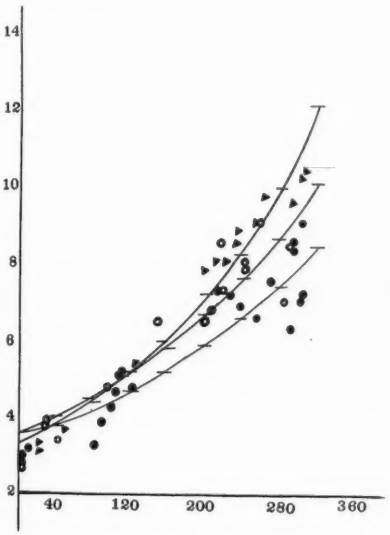

Fig. 6.—Curves showing the difference in rates of increase of mandibular depth of animals in the three food groups. Solid triangle, controls; circle, animals on diet 1; solid circle, animals on diet 3; dash, calculated values for mandible depth.

were examined postmortem and the skulls and selected bones were placed in preserving fluid to await laboratory examination. All other animals were slaughtered, some at 100, others at 200, days of age, and those remaining at various ages from 1 to 304 days. Their skulls also and certain bones were preserved and stored for later examination.

Immediately after being grouped and placed on the diets, the sows, while still nursing the offspring, were transferred to special concrete quarters and permitted to eat of the experimental diets *ad libitum*. The ration mixtures were placed in self-feeders, access to which and to water was had at all times.

The plan of the experiment was such that the deficient diets were fed the sow at various times as follows: (1) during the latter half of the gestation period; (2) during the entire lactation period; and (3) during the second half of this

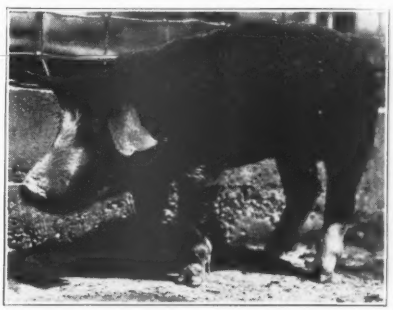

Fig. 7.—Pig on diet 3, approximately 290 days old.

period, in order to determine the effect on the offspring in each case. In a fourth group, the normal young were placed on special rations at weaning. All precautions were taken to eliminate the possibility that the animals might obtain any food other than that supplied them. They were placed in concrete-floored yards, well fenced, so that the three different lots were completely separated from one another.

The diets fed the animals are similar in composition to those fed to rats for the production of experimental rickets.

The three diets, 1, 3 and 4, are approximately the same in composition, and are adequate for growth and development, except with respect to calcium and phosphorus content. Diet 1 is a high calcium, low phosphorus ration. Diet 3 is a low calcium, high phosphorus ration. Both, when fed to rats, produce a severe grade of rickets. Diet 4 is used as the control ration and contains an optimum calcium-phosphorus ratio. The composition of the diets is given in Table 2.

TABLE 1.—EXPERIMENTAL GROUPING OF SOWS

Sow	Bred	Time Experimental Diet Was Begun	Between Ages 1-128 Days Inclusive		
			Off-Spring	Died	Killed
		FIRST BREEDING			
		Lot 4 (Control)			
77	1927	45 days after beginning of lactation.....X	10	5	0
74	1927	46 days after beginning of lactation.....X	7	5	0
82	1927	53 days after beginning of lactation.....X	6	1	0
81	1927	54 days after beginning of lactation.....X	8	1	0
		Diet 3 (Low Calcium, High Phosphorus)			
76	1927	At beginning of lactation.....X	5	4	0
75	1927	45 days after beginning of lactation.....X	8	5	0
72	1927	57 days after beginning of lactation.....X	9	0	0
71	1927	58 days after beginning of lactation.....X	7	6	0
		Diet 1 (High Calcium, Low Phosphorus)			
70	1927	36 days after beginning of lactation.....X	6	2	0
80	1927	39 days after beginning of lactation.....X	6	2	0
73	1927	48 days after beginning of lactation.....X	6	1	0
83	1927	At beginning of lactation.....X	6	2	0
		SECOND BREEDING			
		Control Diet (4)			
77	1928	At middle gestation period.....	7	0	0
74	1928	At beginning of lactation.....	7	0	0
82	1928	At middle gestation period.....	7	7	0
81	1928	At beginning of lactation.....	4	1	0
		Diet 3			
76	1928	At beginning of lactation.....	9	9	0
75	1928	At middle gestation period.....	7	7	0
72	1928	At beginning of lactation.....	6	2	0
71	1928	At middle of gestation period.....	7	7	0
78	1928	At weaning diet fed to offspring.....	5	0	0
		Diet 1			
70	1928	At middle of gestation period.....	6	6	0
80	1928	At beginning of lactation.....	8	8	0
73	1928	At beginning of lactation.....	12	12	0
83	1928	At middle of gestation period.....	7	7	0
78	1928	At weaning diet fed to offspring.....	5	1	0

TABLE 2.—DIETS*

High Calcium-Low Phosphorus

	Parts
Yellow corn	43
Ground wheat	33
Gelatin	5
Wheat gluten	15
Salt	1
Carbonate of lime	3

Low Calcium-High Phosphorus

	Parts
Yellow corn	52
Ground wheat	26
Gelatin	5
Wheat gluten	15
Salt	1
Sodium phosphate	1

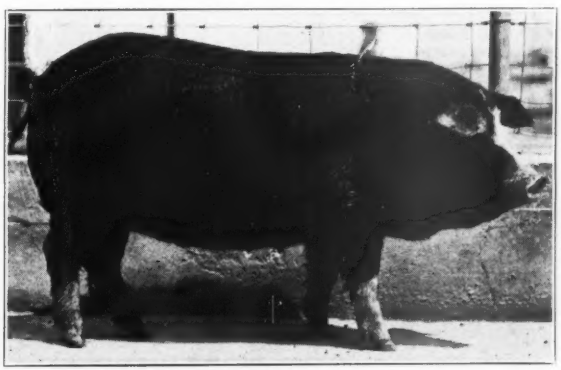

Fig. 8.—Pig on control diet (4), approximately 290 days old.

Normal Ration (Control)

	Parts
Yellow corn	72.5
Milk powder	10
Alfalfa meal	10
Flaxseed meal	5
Salt	1
Carbonate of lime	1.5

*Mixed and fed *ad libitum* in self-feeder.

EFFECT ON THE PERCENTAGE MORTALITY OF OFFSPRING

Table 3 gives the effects of the time at which the diet is begun on the percentage mortality of new-born swine. The offspring of sows which were fed the deficient diets, 1 or 3, throughout the latter half of the gestation period, show a 100 per cent mortality within 128 days after birth, as compared with 50 per cent mortality for animals on the control diet. The offspring of sows which received a low calcium diet (3) throughout the lactation period show a mortality of 75 per cent; those on diet 1, a mortality of 84 per cent, and those on diet 4 (control), a mortality of only 9 per cent. The offspring of sows fed during the latter half of the lactation period on the same diets show a 45 per cent mortality on diet 3, 27 per cent on diet 1, and 38 per cent for controls. All three of the latter figures fall within the range of normal mortality of swine.

When the animals were placed on the experimental diets at weaning, the mortality in the three food groups was low; that is, also within the range for mortality for normal animals.

The figures in Table 4 have been supplied by S. S. Buckley.

EFFECT ON EARLY GROWTH

Weekly weighings of those animals which survived between the ages of 1 and 200 days show the importance, as regards growth of the young, of the period in their development during which the deficient diets are fed. In Figures 2 and 3, the average growth curves for animals in each group are shown.

Definite retardation in growth is observed in animals whose mothers have been subjected during part of the gestation or the lactation period to diets unbalanced in their calcium-phosphorus ratios. The effects on early growth are least severe in animals fed deficient diets after weaning, and most severe in animals whose mothers have been subjected to unbalanced rations during part of the gestation period. When the main objective of the investigation is considered, these observations are of more general interest. They suggest the possibilities for the production of aberrations in dental structure through such procedures. A more extensive treatment of the subject of diets as related to reproduction and growth of offspring may be obtained from the work of Nina Simmonds on the rat.[15]

The fact that deficient diets fed early in the development of the pig may so markedly retard growth is of interest in relation to the possible effects of such feeding on tooth and bone development.

The results to be presented in the remaining portion of the paper were obtained on only those offspring which had received the deficient diets during the latter part of the suckling period, until death or slaughter. The individuals

TABLE 3.—EFFECT OF TIME AT WHICH DIET IS FED ON THE PERCENTAGE OF MORTALITY OF OFFSPRING

Diet	Number of Offspring	Number Died Between Ages 1-128 Days Inclusive	Percentage Mortality 1-128 Days Inclusive
Sows Fed at Middle of Gestation			
4	14	7	50
3	14	14	100
1	13	13	100
Sows Fed at Beginning of Lactation			
4	11	1	9
3	20	15	75
1	26	22	84
Sows Fed Latter Part of Lactation			
4	31	12	38
3	24	11	45
1	18	5	27
Offspring Fed at Weaning			
4	(No control sow used here)		
3	5	0	0
1	5	1	20

15. Simmonds, Nina: Am. J. Hyg., 4:1-108 (Sept.) 1924.

which have come to necropsy range in age from 1 day to 304 days. Only the results on the offspring of those sows marked *X* in Table 1 are reported in this paper. The results on the offspring of sows in the other food groups will be reported in a later communication.

EFFECT ON RATE OF GROWTH OF SKULLS AND MANDIBLES

Since the interest of the dental profession is especially concerned with the structures of the head, particularly those of the jaw, a study was made of the effect of experimental diets on the size and development of the mandibles and skulls of the experimental animals. These effects were determined by measurements

TABLE 4.—PERCENTAGE OF MORTALITY*

	Per Cent
Farrowed dead	7.6
Those which died within twenty-four hours after birth	5.6
Deaths from other causes to time of weaning	21.3
Deaths after weaning	6.0
Total	40.5

*Offsprings from normal sows which farrowed a total of 13,695 young at Beltsville.

of mandible length and depth with the aid of calipers and a steel centimeter rule. The mandible length (Fig. 4) was taken as the distance in a straight line from the center of the interproximal space between the two mandibular first incisors at the point *A* where the space meets the gingiva, to the point *B* on the posterior border of the mandible where it meets the posterior border of the condyle. Mandible depth was taken at that distance in a straight line from the above defined position *(A)* between the mandibular incisors to the lowest point of the symphysis menti *(C)*. The measurements were made on the mandibles after they were dissected from the skull and cleaned of all soft tissue except the epithelium covering the alveolar processes.

Attempts were made to measure the mandibles in the living subject. The softness of the bones of the animals on diet 3 prohibited forcible restraint because of the danger of fracture.

The fact that measurements had to be made on the mandibles after death of the animals necessitated a statistical treatment in order to determine the velocity of growth of mandibles of animals in the three food groups. Tables 5 and 6 give the observed values and also the calculated values for the mandible measurements. The calculated values were obtained by using the method of least squares.[16] When the values for mandible length and depth are plotted over age as the abscissa, it is found (Figs. 5 and 6) that the rate of growth of the mandibles varies significantly in the three food groups. Detailed measurements on the entire skull have not been made. The mandibular measurements may be considered as giving an index to the rate of the entire skull development. A gross examination of the skulls shows this to be the case. Figures 7 and 8 show the differences in size and appearance of animals of approximately the same age, representing the normal and diet 3. When the skulls of these animals are compared, marked differences in size are noted. The differences in size of the mandible of animals of the same age representing the three diets are shown in Figure 9.

The detailed measurements on the mandibles of the animals in the three food groups indicate a significant difference in their rates of growth. These dif-

16. Pearl, Raymond: Medical Biometry and Statistics, Philadelphia: W. B. Saunders Company, 1923.

TABLE 5.—OBSERVED AND CALCULATED VALUES FOR VELOCITY OF GROWTH OF MANDIBLE*

ANIMALS ON DIET 1			ANIMALS ON DIET 3			ANIMALS ON CONTROL DIET (4)		
X	Y	Calculated Y	X	Y	Calculated Y	X	Y	Calculated Y
1	6.0	5.9	3	6.5	7.7	21	7.9	8.8
4	6.3	6.1	29	8.0	8.8	22	7.3	8.9
9	6.9	6.2	30	8.5	8.9	25	7.6	9.0
83	7.3	9.5	44	8.6	9.5	49	8.6	10.2
91	10.6	9.9	97	14.3	11.7	126	13.7	14.1
102	11.2	10.4	152	15.8	14.1 b=0.043	200	19.0	17.8 b=0.050
104	11.0	10.5 b=0.044	201	15.4	16.2	201	17.0	17.8
105	11.2	10.5	209	16.2	16.6 a=7.620	215	19.6	18.6 a=7.800
109	11.7	10.7 a= 5.93	217	18.7	16.9	223	19.3	18.9
114	12.0	10.9	220	17.0	17.0	234	20.5	19.5
125	11.5	11.2	243	19.1	18.0	235	20.5	19.5
213	16.5	15.3	243	19.2	18.0	257	20.9	20.6
226	17.6	15.8	258	19.5	18.7	265	22.5	21.0
239	16.3	16.4	285	16.8	19.8	292	23.0	22.4
257	16.3	17.2	292	19.3	20.1	299	24.2	22.7
270	17.0	17.8				300	22.7	22.8
291	16.0	18.7						
293	19.0	18.8						
293	19.0	18.8						
303	18.7	19.2						
303	18.5	19.2						
304	18.8	19.3						
ΣX 3839	ΣY 299.4		ΣX 2523	ΣY 222.9		ΣX 2964	ΣY 274.3	

*Y = mandible length; $y = a + bx$; X = age.

$na + \Sigma x = \Sigma y$;
$\Sigma xa + \Sigma x^2 = \Sigma xy$.

TABLE 6.—OBSERVED AND CALCULATED VALUES FOR VELOCITY OF GROWTH OF MANDIBLE*

Animals on Diet 1				Animals on Diet 3				Animals on Control Diet (4)			
X	Y	Calculated Y		X	Y	Calculated Y		X	Y	Calculated Y	
1	1.8	1.90		3	1.7	2.10		21	2.3	2.10	
4	2.0	2.00		4	2.3	2.12		22	2.1	2.13	
9	2.2	2.09		8	2.0	2.20		25	2.3	2.20	
83	2.3	3.20		29	2.8	2.60		49	2.7	2.80	
91	2.9	3.40		30	2.9	2.60		126	4.4	4.70	
102	3.3	3.50		44	2.4	2.80		200	6.8	6.50	b=0.025
104	3.3	3.60		44	2.9	2.80		201	6.2	6.60	a=1.580
105	3.7	3.63		58	2.5	3.15		215	7.0	6.90	
109	4.1	3.69		97	3.8	3.80		223	7.0	7.10	
114	4.2	3.77	b=0.016	152	5.5	4.90		234	7.5	7.40	
125	3.8	3.95		201	5.5	5.80	b=0.019	235	7.8	7.45	
213	6.3	5.30	a=1.953	209	5.8	6.00		257	8.0	8.00	
226	6.2	5.50		217	7.5	6.10	a=2.050	265	8.6	8.20	
239	5.9	5.70		220	6.3	6.20		292	8.5	8.80	
257	5.6	5.00		243	6.8	6.60		299	9.1	9.00	
270	6.5	6.20		243	7.0	6.60		300	9.2	9.08	
291	5.3	6.60		258	8.0	6.80					
293	7.3	6.63		285	6.0	7.40					
293	7.5	6.63		292	7.4	7.59					
303	6.2	6.79									
303	6.0	6.79									
304	8.0	6.81									
ΣX 3839	ΣY 104.4			ΣX 2637	ΣY 89.1			ΣX 2964	ΣY 99.5		

*Y = mandible depth; y = a + bx; X = age.

$na + \Sigma x = \Sigma y$;
$\Sigma xa + \Sigma x^2 = \Sigma xy$.

TABLE 7.—OBSERVED AND CALCULATED VALUES FOR VELOCITY OF GROWTH OF TEETH*

ANIMALS ON DIET 3			ANIMALS ON DIET 1			CONTROLS (DIET 4)		
X	Y	Calculated Y	X	Y	Calculated Y	X	Y	Calculated Y
31	2.00	2.08	13	1.60	1.80	126	3.65	3.860
66	2.50	2.68	29	2.30	2.15	200	4.30	4.250
68	2.90	2.70	30	2.40	2.18	201	4.05	4.255
75	2.90	2.80	44	2.40	2.48	215	4.60	4.320 b=.0052
83	2.45	2.90	44	2.40	2.48	223	4.65	4.360 a=3.21
86	3.40	3.00	65	2.95	2.95 b=0.022	234	4.50	4.420
91	3.10	3.10	68	2.95	3.00 a=1.520	265	4.80	4.580
94	2.95	3.15 b=0.017	73	3.00	3.10	292	4.30	4.720
98	3.30	3.20 a=1.560	73	3.40	3.10	299	4.75	4.760
99	3.60	3.24	78	3.15	3.20			
102	3.30	3.29	78	3.20	3.20	ΣX 2055	ΣY 39.60	
104	3.70	3.32	78	3.30	3.20			
105	3.40	3.34						
119	3.20	3.58	ΣX 673	ΣY 33.05				
125	3.70	3.70						
			91	3.35	3.40			
ΣX 1346	ΣY 46.40		91	3.40	3.40			
			103	3.40	3.50			
226	4.0	3.87	108	3.50	3.54 b=0.006			
239	3.9	3.86 b=0.001	209	4.45	4.10 a=2.900			
270	3.8	3.83 a=4.100	217	4.70	4.20			
293	4.0	3.80	243	4.15	4.30			
293	4.1	3.80	285	4.00	4.60			
304	3.6	3.79	292	5.00	4.65			
ΣX 1625	ΣY 23.4		ΣX 1639	ΣY 35.95				

*Y = tooth length; y = a + bx; X = age.

$na + \Sigma x = \Sigma y$;
$\Sigma xa + \Sigma x^2 = \Sigma xy$.

ferences seem to be associated with the differences in adequacy of calcium or phosphorus in the diets fed the groups.

EFFECT ON THE STRUCTURE OF THE MANDIBLE

The observation that dietary deficiencies influence the rate of growth of mandibles and skulls invites an inquiry into the nature of the structural defects which might be expected to follow the retardation in development. It seemed that a roentgenographic examination supported by histologic study of the material would reveal the defects, if any, which have resulted from the experimental feedings. The mandibles were removed from formalin (solution of formaldehyd) and the left and right mandibles were divided by sawing through the symphysis menti. The left mandibles were then examined by roentgen ray. All exposures were as nearly identical as possible with the apparatus available. The films have been developed and fixed with identical fixing and developing times. Sections, including the central incisors, were then cut from each mandible and prepared for decalcification and sectioning.

While growth of mandibles of animals on diets unbalanced in mineral content is retarded shortly after exposure to the experimental diets, the structural changes are not apparent until some time later in the experimental period. Differences, clearly discernible, may be noted in animals as early as from thirty to forty days after the beginning of the deficient dietary régime. The slowing up in structural development is clearly shown in an examination of the roentgenograms of animals of approximately the same age. Figures 11 and 12 show mandibles of animals respectively 83 and 80 days of age. The former had been fed a low

Fig. 9.—Left: Skull of pig (75.1) on diet 3 (low calcium-high phosphorus) (age, 291 days). Center: Skull of pig (73.2) on diet 1 (high calcium-low phosphorus) (age, 292 days). Right: Skull of pig (74.1) on control diet (4) (age, 292 days).

calcium diet for thirty-eight days, twenty-five days of which the animal was suckled by a sow which was also being fed a low calcium diet. The latter represents a mandible of an animal, 3 days younger, on the control diet. No striking gross structural aberrations are to be noted except the general slowing up of mandibular development in the animal on the low calcium ration.

consumed milk from a sow on the same diet. Figure 14 represents the left mandible of a 200-day-old animal on the control diet. The animal on diet 4 is thirty-nine days younger, and yet the calcium deposition in the bone has progressed much farther.

The contrast in developmental perfection is quite clear. We notice that in addition to the observation that the man-

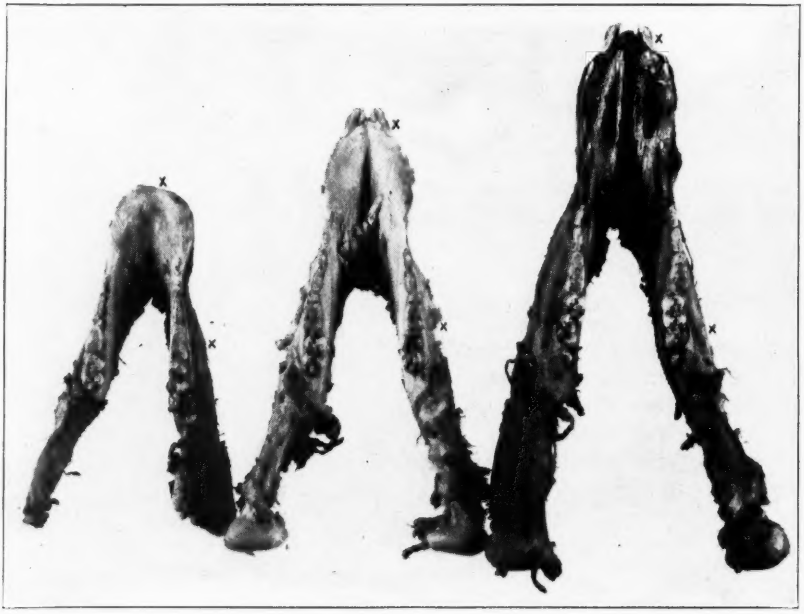

Fig. 10.—Comparison of mandibles of three skulls shown in Figure 9. Note wear on tooth surfaces at *X*. (The exposure time, target distance, developing and fixing times and temperature were for all roentgenograms as nearly identical as possible with the apparatus available.)

When animals are kept for longer periods on the same diets, more marked developmental retardation is evident. Figure 13 represents the roentgenogram of the left mandible of a 239-day-old animal, 182 days on a low calcium diet, thirteen days of which the individual

dible of the animal on low calcium is slower in developing, certain defects are present. When Figures 13 and 14 are studied in more detail, it will be observed that there exists an absence of bony structure of the alveolar process. The teeth, especially the molars, are

partly enclosed in bone of poor quality. Approximately three-fourths of the root is not enveloped by bone and is enclosed only by tissue which permits the penetration of roentgen rays. This is in sharp contrast with the conditions existing in a normal animal, in which a sharp dense bony structure is noted. The teeth are well enclosed in solid compact bone. The teeth themselves present a more densely calcified structure.

When diet 1 is fed to rats, rickets develops. When fed to swine, it is found that, although development of bone is retarded, the structure, and especially that of the alveolar bone, is not so markedly altered as in the animals on the low calcium, high phosphorus diet. Figure 15, taken from an animal 209

Fig. 11.—Mandible of pig (specimen 5215) on diet 3 (age, 83 days).

days old, illustrates this point. It is seen that the development of the mandible is not so much retarded as in that of the animal on diet 3. The structure approximates that of the normal, and, in some cases, it cannot be distinguished from it.

This observation focuses attention on the importance of species differences in reaction to a specifically deficient diet.

If the animals are subjected to longer periods on the mineral-deficient diets, more serious defects in structure are noted. If they are permitted to eat the experimental diet for from 240 to 250 days, most striking defects in mandibular and tooth structures are observed. Examination of roentgenograms of animals of approximately the same age reveals the gross changes. Figure 16 represents a roentgenogram of the mandible of a control animal 299 days old. The excellence of bone structure, the dense alveolar bone formation and the well-calcified tooth structure are all seen. Figures 17-19 illustrate the conditions existing in animals respectively 293, 303 and 293 days old, on a low calcium diet for respectively 236, 246 and 236 days. The marked changes in the jaws and alveolar bone are clearly discernible. Supporting alveolar bone is absent, as indicated by roentgenographic examination. The tooth germs are malposed, and in one case, those of the second and third permanent molars are markedly disarranged.

Since density in a roentgenogram is defined as the logarithm of the opacity, it may be concluded that, as a whole, all the mandibles of animals on a low calcium diet show a lesser degree of calcification than those of normal animals. This conclusion is further substantiated when the mandibles are cut for sections. The bone of those animals on diet 3 may be cut with a sharp scalpel without difficulty. The sectioning of the mandibles of those on diet 4 requires a sharp tooth saw and considerable muscular effort.

In animals which have been fed a high calcium diet for approximately the same length of time, less marked changes are demonstrable. The structure of the bone is apparently affected very slightly, if at all. The rate of growth is retarded. (Fig. 20.) These results differ from the effects of the same diets on rats. The reasons are being investigated.

The differences in effect of the low calcium diet and the high calcium diet are shown in Figure 21.

EFFECTS ON DEVELOPMENT AND STRUCTURE OF THE DECIDUOUS INCISOR TEETH

The results as regards rate of growth of mandibles and the effect of the deficient diets on the structural makeup of the mandible and alveolar processes have led to an inquiry into the determination of the effects of the same diets on the rate of growth of the incisor teeth and the effects on their structure.

The left deciduous central incisor was chosen as the tooth to be examined because its extraction involved the least difficult and time-consuming procedure. The tooth was denuded of all bone and the surrounding soft tissues dissected away. The determinations on tooth growth have been made by length measurements. Tooth length was taken as that distance in a straight line from the highest point on the crown to the root apex. Measurements made with calipers and a steel centimeter rule indicate that the incisor teeth from animals in the three food groups vary significantly in their lengths. The teeth of the control animals are longer, thicker and more highly developed than those in the other food groups. The striking contrast in size of teeth from animals in different food groups is shown in Figure 22. The average values for measurements on the incisor teeth from animals in each food group, ranging in age from 20 to 300 days, have been plotted by the method of least squares. The curves relating increase in length of tooth with increasing age for the three food groups are shown in Figure 23. The observed and calculated values for the determination of the curves is given in Table 7. The rate of growth of the teeth from animals on diets 3 and 1 are significantly less than the rate of growth of incisor teeth from animals in the control group.

Roentgenograms of individual incisor teeth indicate the marked structural retardation. (Figs. 24-28 and 32.)

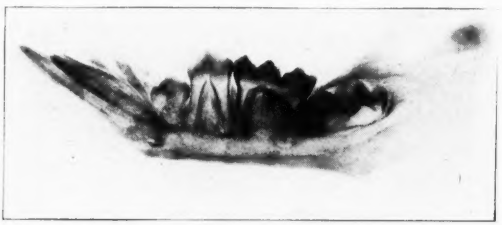

Fig. 12.—Mandible of pig (specimen 5209) on control diet (4) (age, 80 days).

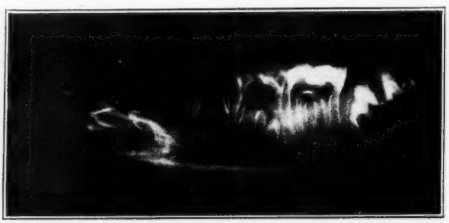

Fig. 13.—Mandible of pig (specimen 5245) on diet 3 (age, 239 days).

COMMENT

That inadequacy of calcium or phosphorus in the diet constitutes a factor in the production of poorly calcified alveolar bone in swine is an observation which is of some interest. Certain workers are inclined to stress the dangers in applying observations made on animals to conditions found in man. Such criticisms are to some extent permissible and should be considered in any attempt to interpret conditions found in man on the basis of experimental results particularly in the case of small animals. Such criticism is less justified when larger animals are used.

A careful search of the dental literature yields little information as to the effects of deficient diets on the incidence of periodontal lesions. A study of the findings of those who have been interested in the possible relation of diet to periodontal disease reveals certain correlations which have been established.

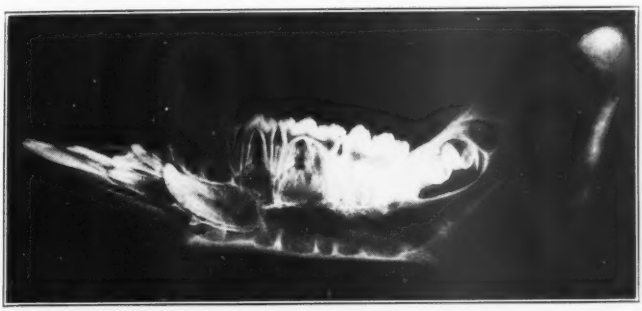

Fig. 14.—Mandible of pig (specimen 9952) on control diet (4) (age, 200 days).

Fig. 15.—Mandible of pig (specimen 5272) on diet 1 (age, 209 days).

Martha R. Jones,[17] working with

17. Jones, Martha R.: Proc. Soc. Exper. Biol. and Med., 23:724 (May) 1926.

Fig. 16.—Mandible of pig (specimen 9960) on control diet (4) (age, 299 days).

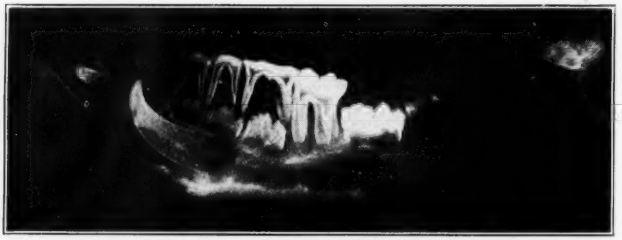

Fig. 17.—Mandible of pig (specimen 5290) on diet 3 (age, 293 days).

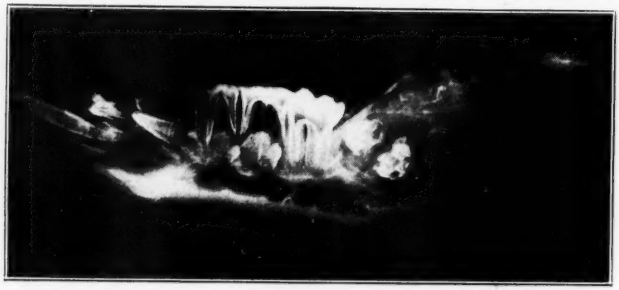

Fig. 18.—Mandible of pig (specimen 9964) on diet 3 (age, 303 days).

dogs, has shown that, in the absence of sunshine, two factors are concerned in the deposition and resorption of bone in puppies, the first being the metabolic state, which is inherent in the individual, and the second, diet. She finds that diets low in calcium, protein and vitamins, with or without the addition of sodium carbonate, result in retrograde changes in the alveolar bone of healthy adult

dogs. These changes are identified as halisteresis of the crests of the septal processes, osteoporosis and lacunar resorption of the ends of the roots of the teeth.

A. Hojer and G. Westin,[18] who have reported work on scorbutic changes in the teeth and jaws of man, suggest that latent scurvy may constitute a factor in the production of "marginal paradontosis."

Recently, Benjamin Tischler[19] reported, in an analysis of 101 cases of periodontoclasia, that 96 per cent of the patients, ranging in age from 18 to 63 years, had an unbalanced diet. It was found that three items in particular were low; namely, calcium, vitamin A and liquids (water).

The ingestion of a diet low in calcium constitutes an important factor in the production of defective alveolar bone in swine. It seems not at all improbable that the ingestion of such a diet in man may constitute also an important factor in the production of poorly calcified alveolar bone structure, and so form a very probable, although not as yet a definitely proven, etiologic factor in certain

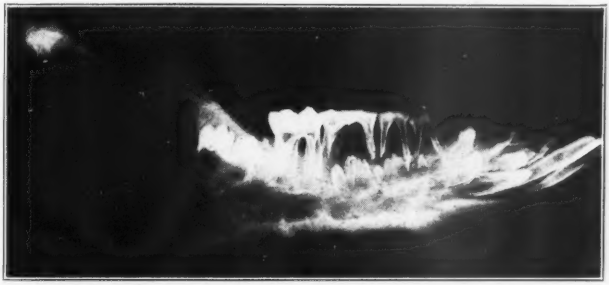

Fig. 19.—Mandible of pig (specimen 5297) on diet 3 (age, 293 days).

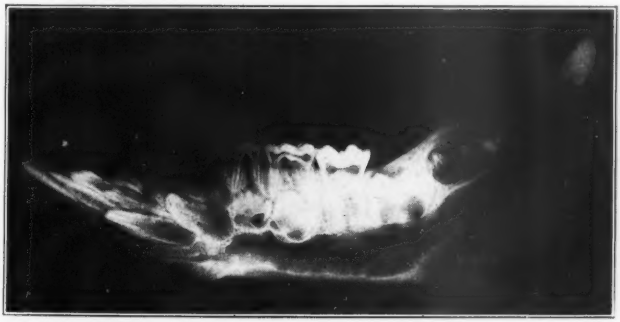

Fig. 20.—Mandible of pig (specimen 9969) on diet 1 (age, 292 days).

18. Hojer, A., and Westin, G.: Dent. Cosmos, 67:1 (Jan.) 1925.

19. Tischler, Benjamin: Diet Analysis of One Hundred and One Periodontoclasia Cases, J.A.D.A., 16:1037 (June) 1929.

nonsuppurative forms of pyorrhea alveolaris.

Examination of the roentgenograms indicates the effect on alveolar structure which may be produced in a relatively large animal whose alveolar and tooth structure simulates that found in human beings. The absence of radiopaque areas in the alveolar processes of the swine studied indicates an absence of calcified bone. No attempt will be made in this paper to explain the exact mechanism by which such poorly calcified bone may be produced. The investigation of such a problem is beyond the scope of the present report but will be dealt with in following communications.

Although the importance of determining the possible microscopic effects of deficient diets on the tooth germs and early tooth structure is fully appreciated, the present communication is concerned only in determining the gross effects on the entire dentition microscopically.

The experimental results here described indicate the direction in which further work will be undertaken and are to be considered as preliminary to a fuller and more detailed project in which all factors relative to the possible effects on the dental structures of dietary deficiencies will be thoroughly investigated.

Fig. 21.—Above: Mandible of pig (specimen 5260) on diet 1 (age, 258 days). Below: Mandible of pig (specimen 9966) on diet 3 (age, 304 days).

SUMMARY

1. The offspring of sows fed, during gestation, lactation or the period subsequent to weaning, on diets unbalanced in calcium or phosphorus but exposed to sunlight have a percentage mortality within 128 days after birth which is highest for offspring from mothers so fed during gestation, and lowest for offspring subjected to such diets at weaning. Off-

Fig. 22.—Two teeth from animals each 300 days old (upper tooth from animal on diet 3; lower tooth from animal on control diet (4).

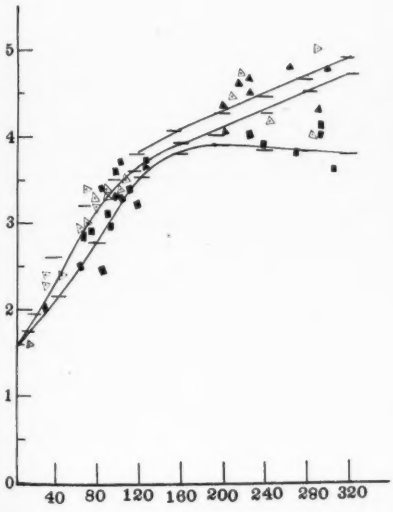

Fig. 23.—Curves plotted using the method of least squares, showing the relative differences in rates of growth of incisor teeth from animals on the three experimental diets. Solid triangle, observed values on control diet (4); open triangle, observed values in animals on diet 1; rectangle, observed values in animals on diet 3; dash, calculated values.

spring from sows so fed during the lactation period show a percentage mortality intermediate between the two above mentioned groups—3 and 4.

2. The growth of offspring from these sows within the ages of 1 to 200 days is greatest for those on deficient diets after weaning, and least for those from mothers fed on deficient diets during the gestation period.

3. The rate of growth of mandibles and skulls of animals fed, during the suckling and early growth periods, on diets unbalanced in calcium and phosphorus is less than that of the control animals.

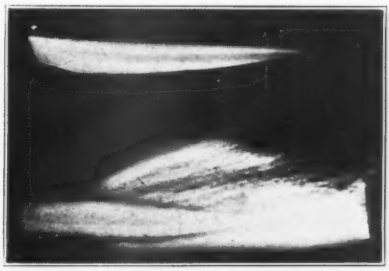

Fig. 24.—Mandibular incisor teeth, left and right, of pig (specimen 9963), on control diet (4) (age, 292 days).

4. The mandibles and alveolar processes of these animals (fed on diets 1 and 3) are of a poorer structure than those on the control diets.

5. The rate of growth of the incisors of the same animals (on diets 1 and 3) is less than that of the controls. The structural development of the incisor teeth of these animals on diets 1 and 3 is similarly retarded.

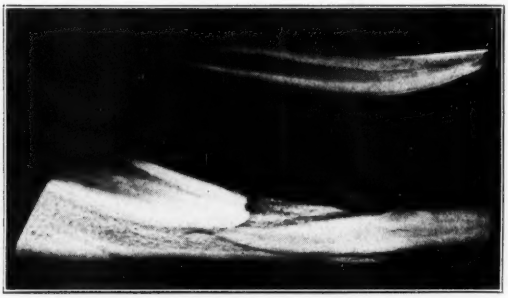

Fig. 25.—Mandibular incisors, left and right, of pig (specimen 9969) on diet 1 (age, 292 days).

Fig. 26.—Mandibular incisor teeth, left and right, of pig (specimen 9965) on diet 3 (age, 303 days).

Fig. 27.—Group of mandible incisor sections (control diet).

Fig. 28.—Group of mandible incisor sections (diet 3). The downward slope of the curve for the teeth of animals on diet 3 is due to the excessive wear observed in the animals on the low calcium diet. Diet 3 is less abrasive (as determined roughly by rubbing between the fingers) than either diet 1 or the control diet (4).

INSTRUMENTATION*

By JUSTIN D. TOWNER, D.D.S., Memphis, Tenn.

IF the dental profession is ever to be regarded as a group of health specialists, in the full significance of the term, or if the general practitioner is to wholly discharge his obligation as such, the prevention and cure of periodontal disease must be a fundamental part of practice. All who appreciate the necessity of this work and make a determined effort to master its rather simple details can develop ability to render this much needed service.

The objects to be attained in this specialized instrumentation are the removal of deposits and all foreign material, smoothing and polishing of denuded and infected cementum, excavation of necrotic tissue at the base of the crevice, and elimination of epithelium from the periodontal wall. To accomplish this and leave the involved tissues in a condition favorable to recovery and regeneration is not beyond the ability of any one who recognizes the importance of these lesions and desires to become proficient in their treatment.

In this branch of practice, the selection and use of instruments is of prime importance. The proper use of instruments, or their efficacy in treatment, depends so largely on design that selection becomes an important consideration in the discussion of instrumentation.

*Read before the Section on Periodontia at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 9, 1929.

*The papers of Drs. Towner, Stillman, Charters and Merritt were presented as a symposium on "Practical Periodontia Problems of the General Practitioner."

INSTRUMENTS

Instruments intended for the specific treatment of cementum and dentin are termed scalers and are classified as chisels, curets, hoes and files, according to the design of cutting edge and its relative position to the blade. Those designed solely for soft tissue work, such as removal of epithelium and the incision or excision of gingival structures, are called spoons and resectors, respectively.

Chisels.—The blade of a chisel is straight, terminating in a bevel of one side. This constitutes the cutting edge, or working plane, which is the actual end of the instrument. It operates with a push stroke, will penetrate restricted areas and is intended for use on hard tissue only. By reason of its tendency to nick or groove cementum, special care must be exercised in its operation.

Curets.—The curet has its working plane at an obtuse angle to the blade, or is so designed that the blade itself is applied at an angle of 45 degrees to the surface under treatment. In this manner, the plane forms the actual end of the blade, as the chisel, and permits both the push and pull operative stroke. This form also makes possible its extension into restricted areas for the removal of disorganized tissue which precedes deposits. In fact, it is a combination chisel

and hoe with the desirable attributes of both and none of the respective disadvantages.

Hoes.—The hoe is essentially a chisel with the cutting edge bent at right angles to the blade; which removes its working plane from the end of the instrument and reverses the operating stroke. This type blade will not penetrate so deeply into restricted crevices as either the chisel or the curet, and for this reason is used to better advantage in horizontal pockets. In an emergency, it may serve as an aid in removing periodontal epithelium.

Files.—The file has a number of working planes given off at acute angles to the blade. This, like the hoe, necessitates a protrusion of the blade beyond the first serration, which prevents its operation at the pocket base. To overcome this fault, pyramid serrations have been offered, but since this type loses much of the positive action of the standard cut, it has not become popular. As a finishing instrument in root treatment and for reducing protruding margins of fillings and crowns, it is very desirable.

Spoons.—Specially designed spoons are needed in the adequate instrument armamentarium. These, if fenestrated, will remove the epithelial layer and stimulate the underlying connective tissue to a marked degree without injury. Such instruments can be quite delicate, as little force is required in their operation.

Resectors.—These are small knives which should cut on either side and at the end. As the name signifies, these are designed for incision and resection of excessive gingival tissue, when such is made necessary by the failure of conservative treatment to effect its reduction or reattachment.

Number of Instruments.—From the great variety of instruments offered for selection, it is possible to assemble a competent set of comparatively few numbers. While there is no single type which will satisfy all the requirements of periodontal surgery, the curets, with three or more cutting edges to each blade, seem more nearly to meet the demand of economy by reason of the fact that the working range of each instrument is greatly increased. Then, too, there is the additional advantage of the push-pull stroke, which reduces the number of finishing instruments to those needed for the smoothing of margins of fillings and crowns. The advisability of checking the work of one instrument with another of different type is also largely obviated by use of curets, provided the area being treated is crossplaned. The number of instruments actually needed depends on the operator's choice of type, length and angle of blade. A set of from thirty to thirty-six in number, each blade having three working planes, seems sufficient for all purposes.

Group Position.—The relative position of any group of teeth, such as anterior teeth, bicuspids and molars, to the median line determines the length and angle of the blade. This refutes the idea that all blades should be of similar length regardless of their angle. Tooth outline, occluso-apically, should govern the concavity or convexity of the blade, the rule being that the curvature of the blade should closely follow tooth form in the path of its working plane.

Specials.—Occasionally, because of irregular position, malformation, unnatural length of teeth or a partially closed bite, special instruments are demanded. These should have blades at slight variances in length, angle and form from the major groups mentioned.

Bifurcators.—Bifurcation and trifucation areas suggest another group of

instruments the blades of which should be very delicate, with length and angle similar to the special instruments, of concave form and working plane given off at a gradual curve, ending in an oval tip. With these, it is possible to gain direct access to and thoroughly treat such areas.

Shank.—Both length and size of shank are important considerations, as they bear a definite relation to a positive working plane. A short shank brings the blade end nearer the shaft, which affords better control because the grasp is on the shaft, where it should be, instead of the shank, as is the case when this requisite is ignored.

Shaft.—The size, form and character of shaft demand special consideration. The size must be sufficient to permit a firm and delicate grasp. Firmness is essential to positive control and delicacy of touch. A size at least one quarter inch in diameter seems necessary in order to avoid heavy finger pressure in management, which will benumb digital perception. The form of shaft which is most suitable, and for this reason generally used, is the octagon. Properly serrated and of sufficient size and length, this type of shaft possesses distinct advantages over those of other designs. The hollow shaft is distinctly indicated by reason of its light weight compared with size, extreme sensitiveness of touch and splendid conduction of sound, all so necessary to complete the discriminating instrument demanded in periodontal practice.

INSTRUMENTATION

Treatment of the periodontal pocket is a distinct surgical procedure, demanding a thorough understanding of oral and physical conditions and intelligent selection and use of instruments, as well as persistent and painstaking effort. The first requisite, then, is a clear conception of the anatomy and histology of the periodontal structures and cementum, together with an intimate knowledge of their complex pathology.

An important fact is that all recovery is dependent (1) on tissue resistance, local and systemic; (2) on the patient's cooperation in permitting proper service, maintaining mouth hygiene and observing the fundamental laws of health; and (3) on definite periodontal treatment. This does not underrate the importance of instrumentation, as it would seem, but simply means that it cannot effect a cure when the other two requisites for success are negative. The skilful use of instruments selected to meet the most exacting demands of approach, control, delicacy, sensitiveness and positive working plane is as fundamental to success in periodontal surgery as a knowledge of the histopathology of the structures involved and their hygienic after-care.

While local treatment of periodontoclasia is almost wholly instrumental and is applied to exposed and denuded tooth surfaces and periodontium, the simple removal of deposits will not effect the closure of deep seated pockets. The cemental wall must be smoothed and polished and periodontal epithelium destroyed. This seems sufficient to remove mechanical irritants, reduce bacterial invasion and stimulate cell vitality to ultimate recovery, provided there is no specific infection and proper hygiene is maintained.

In the removal of subgingival deposits, necrosed cementum and degenerated periodontal tissue, approach should be made with precise and delicate touch, which precludes unnecessary injury. Even in the absence of instrumental trauma, infection is driven directly into soft tissues during instrumentation, and

for this reason, too many teeth should not be treated at any single period, the number being governed by severity of the disease, tissue resistance and tolerance of the patient. Direct tissue infection may be made to serve as a form of vaccination, thus favorably influencing recovery and immunity, provided the patient is not overdosed.

All instruments should be delicate, sharp and sterile. Blades should be thin enough to enter and treat restricted areas without traumatizing soft tissue; sharp to facilitate discriminate treatment with least discomfort, and sterile to prevent the introduction of alien micro-organisms.

Approach.—Regardless of the type of instrument used, the form, length and angle of blade should be such as to facilitate approach, fulcrum and grasp. Approach which will not necessitate opening the mouth to the point of pain at the glenocondyloid articulation or distend buccal tissues extravagantly is most desirable. With the blades of suitable length and proper angle, approach to bicuspids and molars may be made with the position of the shaft near the median line and midway between the superior and inferior arches. Anterior teeth are more approachable except in the case of retruded lower teeth, and even here a blade of suitable length and angle will carry its working plane to place within a small opening. This is not supposed to be understood as opposing liberal access, so essential in all mouth operations, but rather as a plea for the consideration of approach in selection and use of instruments.

Grasp.—Of the two grasps, pen and palm, the former lends itself to a more delicate control and sensitive touch. Not only this: it obviates the necessity of contortions, or frequent change of position, of the operator. With the pen grasp, it is possible either to stand or to sit in front and slightly to one side of the patient while treating any upper or lower group of teeth. It is more desirable to change instruments than either grasp or position.

The palm grasp permits more force and positiveness in operating, but this is at the expense of sensitive touch, which is the greater requisite to success in practice. The instant a plane sinks into a periodontal pocket, it is lost to sight, and dependence must then be placed in the feel, or touch, for accuracy in determining efficient operation. This grasp is more suited to the practice of radical surgery than conservative for the reason that either in resection or in excision of soft tissues, the cementum and alveolar process are exposed to view, but, even then, it demands various changes of operative position.

Fulcrum.—A definite rest, or fulcrum, is essential to positive instrument control. Without it, much injury to both hard and soft tissues may be done at the expense of efficient treatment. No technic is comprehensive which does not include the consideration of a proper support from which to guide the instrument. This should be positive and, when possible, placed on teeth of the same jaw as is the field of operation and near it. In certain cases, where this cannot be done, soft tissue must be made the site of rest as this is better than no rest at all. The finger fulcrum stabilizes the pen grasp, while the thumb fulcrum serves the palm grasp in a similar manner.

With short positive, though delicate, strokes extending farther apically each time, thus clearing the instrument path and gradually encompassing the circumference of the root, changing instruments rather than position, a simple and definite

technic may be established. In cases wherein no particular area presents an emergency, it is well to establish a point of beginning and follow the denture in sequence until instrumentation is completed. In addition to removal of deposits and polishing the tooth surface to definite limitations of the pocket, the alveolar process, when exposed or necrosed, should be lightly cureted for the sake of stimulation, and the soft tissue wall should be denuded of its epithelium and pathogenic granulation tissue. This should follow in the order named, to the point of establishing a blood clot and its protection. So essential is plasma to tissue building, that the clot, when once formed, should not be disturbed, especially by means of the pneumatic spray. In case the spray is deemed desirable, it should be used before hemorrhage ceases.

Another pertinent suggestion is that instrumentation should not stop within the interdental space. In other words, all surfaces approximating the space under treatment should be thoroughly operated on in order to avoid undue inflammation and possible injury of the septal tissues. The secret of successful instrumentation is to treat each area definitely and give Nature an opportunity to bestow its benefaction.

DISCUSSION

A. H. Merritt, New York City: It was not so long ago that dentists were divided into two groups: those using curets, and those using planes; and the feeling seemed to exist that the one group could not use the instrument employed by the other with entire success. We have come to realize that this is no longer true. Most periodontists make up their own sets, choosing of the different types that are available those instruments which they find best suited to their needs. The advantage, as I see it, of curets over planes, is that the curet provides a more delicate sense of touch than is possible with a plane instrument. It also has the advantage of breaking up the epithelium lining in the surface of the pocket much more satisfactorily and with more certainty than is possible by the use of planes. Moreover, it causes less trauma, because it is more delicate; with the result that its use, as a rule, is less painful than is the use of planes. Dr. Towner has referred to the push and pull stroke, which, of course, all of us use to a certain extent; but it has been my observation that the push stroke is to be avoided wherever possible, even though one may not cause pain by its use. When it is used, the patient is always apprehensive, seemingly fearful that the instrument is going to slip; and even though it does not, it has a psychologic effect that is undesirable. Dr. Towner calls attention to the fact that these operations are essentially surgical. That, in a sense, is true; nevertheless I believe that there should be some way of discriminating between the operation on the root surface which he has described, and that which is purely surgical. I think that this has been felt by others doing this work; which explains the introduction into our nomenclature of the term apoxesis for describing this operation. The disadvantage of any new terms is that it may never come into common usage. My own feeling is that a better term for this operation as described by Dr. Towner is "curettage," a word which has a well-established connotation. Every surgeon knows what it means, and when it is qualified by the term "subgingival," we have defined quite satisfactorily what is meant by this operation on root surfaces. We can then apply the word "surgery," when surgery is actually employed, in the sense in which that word is generally used. When we resect the gums or perform a flap operation, we are in the field of surgery. This can hardly be said of the operation of subgingival curettage. I should like to suggest to periodontists that, in the future, this distinction be made, as it will be less confusing than the use of a term unknown outside the field of periodontia. "Subgingival curettage" is a term that is at once logical and scientific. Dr. Towner is right in emphasizing the fact that this operation of subgingival curettage is not simply for the removal of deposits. The general practitioner of dentistry has too often thought that he had only to scale the teeth, that this was all that was necessary. As a matter of fact, there is usually some slight calculary deposit on the denuded root surface of a periodontal pocket, but, in many in-

stances, it is not at all obvious. What is needed is that the entire root surface is curetted, not only for the purpose of removing any calculary deposit which may be upon it, but also in order to eliminate sepsis from the surface. Every such surface is septic, being more or less covered by the remnants of the dead pericementum which attaches itself to the cementum. It must, therefore, be gone over, not only to remove the calculary deposits and septic tissue, but also to leave it, as Dr. Towner has said, smooth and polished in order to get a physiologic adaptation of the soft tissue to the root surface. The danger of anaphylaxis to which Dr. Towner refers has always to be considered, but in those cases in which there is no operative trauma of the tissues (and there need not be any), it is not a serious factor. It serves, as Dr. Towner has said, as a sort of autovaccination, which in some instances may be desirable. The control of instruments in operating is a matter of importance. No two men will operate in just the same way, but it is essential that certain principles be observed, one of which is that the hand holding the instrument be under complete control. Dr. Towner says that it is desirable, wherever it can be done, that the hand be poised on the teeth of the jaw on which one is operating. Another satisfactory way in which to rest the hand is on the fingers of the left hand, as this holds back the tongue and lips from the operative field. There are places, of course, where this cannot be done. Also the sequence in which instruments are used is exceedingly important. They should be brought to bear at the point where one is operating and should not be laid aside until the work which that instrument is intended to do is completed. It may then be laid aside and another brought into use. One of the charges made against periodontia is that it is expensive, and that may be true if inefficient methods are employed. Time is the cost element in any method of procedure. Therefore, the proper sequence in the use of instruments is highly important for, in this way, the time element can be greatly reduced. Referring to the so-called granulomatous tissue, which is said to cover the inner wall of pockets: It should be said that this is misleading. It is a granulating, rather than a granulomatous, tissue. For this reason, the removal of this tissue in operating is not so important as it has been believed to be. If one gets rid of the conditions causing this granulation of tissue, it will be automatically overcome in most instances.

J. R. Boone, Bargetown, Ky.: I should like to ask Dr. Towner if he uses sodium sulphid to destroy the epithelium in the periodontal pocket. If not, why not?

Dr. Towner (closing): The discussion of instrumentation, needing many explanations, is not easily limited. I am glad Dr. Merritt mentioned the difference between the pull cut and the push cut instrument. How many here would attempt to erase a crayon mark with one stroke, or even a series of one way strokes? The efficient way, and that which is most natural, is to use reverse strokes. This happens to be the best way to clean, smooth and polish any surface, especially that of a tooth root. We may well get a lesson from the piano finisher whose product is the result of a smoothing process in which reverse strokes are used. If, in planing, we work up and down and then crosswise, we crossplane every surface with the same type of blade, thus avoiding the use of numerous instruments. This is what Dr. Stillman meant when he emphasized checking up the work of one instrument with that of another. In this way, it is possible to get a tooth root free of deposits or pits; one that will be favorable to reattachment. The end of the instrument should be its working plane. As stated in my paper, this permits its introduction into restricted areas without so much injury as results from the use of the hoe type, or other forms in which the working plane is distal to the end of the blade. Such an instrument is perhaps the most difficult to master at first, but this is more than compensated for by the development of a definite and rapid technic. I say this for the benefit of those who contemplate new instrument equipment. A fact to bear in mind is that tissue degeneration precedes serumal deposits, and that if one is content to remove such concretions only, the focus will doubtless remain. Instrumentation must include the area beyond the deposit to effect a cure and establish immunity. Failure to do this is responsible for subsequent outbreaks of the same disease, because the focus has never been removed, although evidences of the disease have been. The essential factor there is definite procedure, not indifference. If there is any work in the realm of dentistry which will not permit of foolishness, or one with which we cannot play, it is the treatment of periodontial lesions. We cannot deceive Nature, our greatest ally, be-

cause it is more exacting than kind in such cases. It draws a distinct line, and treatment is either a success or failure according to its pronouncement, not ours. The other point mentioned in the discussion was the removal of the epithelium of the soft tissue wall. Considerable inquiry has been made regarding my attitude toward this squamous epithelium and my method of removing it. The presence of either this or granulomatous tissue within the periodontal pocket delays recovery and prevents reattachment; therefore, its removal is an essential part of such treatment. This may be accomplished either by chemical dissolution or curettage, or preferably both. Rough surgery will sometimes prove effective because the tissue, as has been said, is disorganized; hence, the advantage of breaking it up and stimulating local resistance to the point of throwing it off. This is often done inadvertently by operators who have little regard for soft tissues, and constitutes the only excuse for such empiric procedure. With special curets, mentioned in my paper, this phase of treatment may be done definitely and delicately. Dr. Boone refers to the use of the sodium sulphid preparation for dissolution of epithelium. This prescription, given us by J. O. McCall, is one of the best drug combinations given dentistry in years. I say this in the presence of those who know my opposition to the use of drugs in the treatment of periodontal disease. This agent will dissolve epithelium and leave a blood clot, the plasma of which goes to rebuild tissue. It is well to follow a five or ten minute application of this solvent with thorough, though light, curettage to remove all residue. Recitation of one experience, without mention of technic, will serve to show the dependence which may be placed in this combination of drugs. An antrum case in which two flap operations failed to close the mouth opening, on account of insufficient tissue integrity, was treated with this preparation. The orifice was larger after the second operation than originally, and in other respects this served as an ideal test case. A ten minute treatment every four days was given the first few weeks, and then once a week over a period of six weeks, when complete closure resulted. No instruments were used to aid in the removal of the epithelium or its residue. Any drug, or combination of drugs which will stimulate tissue to span such a gap is worth using in periodontal pockets. I commend the following formula to you: sodium sulphid, 70 grains; sodium carbonate, 20 grains; distilled water, 1 ounce.

OCCLUSION*

By PAUL R. STILLMAN, D.D.S., F.A.C.D., F.A.A.P., New York City

THE word "occlusion," as a title for a paper, furnishes a subject of such great scope that it would be unwise to attempt even to indicate herein all of its implications. The subject of occlusion is not new, and it is therefore unnecessary to define it, or to insist on its importance in dentistry. In considering the probable scope of the symposium in which this paper appears, I have elected to confine myself, for the most part, to a discussion of the biologic and physiologic aspects of occlusion, and the relationship between the physiologic and pathologic, as manifested in the mouth.

Dentists have by now become accustomed to the thought that a deranged occlusion is to be looked for when a mouth shows advanced periodontal disease. But there still is an evident lack of appreciation in our profession of the fact that occlusal disbalance may be pres-

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ent in many mouths which have not developed serious periodontal disorders, but in which there is, nevertheless, disturbance of the dental apparatus which may have considerable significance.

There has been too much complacency among dentists with the average masticating apparatus. The fact that the upper and lower teeth were capable of meeting in some sort of occlusal contact has been taken as an indication that the function of the teeth was normal. In other words, if the patient has been able to masticate his food with fair efficiency and comfort, it was assumed that he enjoyed functional occlusion. The orthodontists have tried to educate us as to the fallacy of such an assumption, yet the orthodontists have not gone far enough along the road which they have mapped out for themselves. This is not meant as a criticism of this group of specialists, for we must give praise to the work which they have already done. It has been their misfortune to conduct nearly all of their operations in the mouths of the young, in whom there exists a remarkable tolerance to the irritations of occlusal disbalance.

Nor does normal occlusion as herein used have reference merely to the mesiodistal or buccolingual arrangement of the teeth, as observed in plaster-of-Paris casts. Only living things have biologic function and nothing could be more lifeless than a plaster cast, unless it were a photograph of one. Equally true is it that the plaster casts of the teeth fail to convey to the observer the real interaction of the teeth against each other in the movements of mastication. This shortcoming may be partly overcome by mounting these casts in an adjustable articulator. But even here we still fall somewhat short of the ideal, largely because of the fact that there can be no way of reproducing the resiliency and the variations in resiliency of the supporting tissues of the individual teeth.

Those who have studied the effects of traumatic occlusion in older individuals have become impressed with the fact that a truly normal function is only possible when there exists the most accurate occlusal adjustment of the teeth of the mandible to those of the maxilla. The term normal function is here used with reference to the health requirements of the individual teeth and their investing tissues, rather than as a term to designate the ability of the individual to prepare food for deglutition.

The first requirement of ideal dental function, and one which is quite obvious, is that all of the teeth should be present, with the possible exception of the third molars, and also that they should be in good alinement. The alinement of the teeth should be such that there is no excessive overbite of the anterior teeth, nor much overlapping of cusps in the posterior region, as will result in interference with either protrusive or lateral contact excursions of the mandible. Each tooth should have its correct anatomic form, and this must provide for intercuspation with the occlusal antagonists of the opposite jaw. All of these requirements are accepted by those who have studied the dental mechanism, but there has been a lack of sufficiently refined interpretation as to the various points enumerated.

Few natural dentures show the perfection of form and alinement of teeth which are requisite for a truly physiologic function and consequently for enduring health of the periodontal tissues. And, in many instances, even when the form and alinement are very nearly perfect, the individual fails to develop muscle habits which will provide, through

natural wear, for an elimination of slightly interfering cusps and elevations, such as abnormally heavy marginal ridges.

In order that shortcomings in the form of individual teeth which produce aberration of their functional relationship to each other may be overcome, it is necessary that wear shall take place. This we designate as functional wear. And this takes place only when teeth are given correct and complete functional use. Let us emphasize the word "correct" here, for a moment, because it is a fact that teeth frequently show marked wear as a result of their use in function, yet are not improved thereby as to their actual functional relationships. This is due to the establishment of a habit of employing a limited excursive movement of the mandible. It is, of course, true that the departures from the normal form of individual teeth and of the dental arches themselves are often so gross that the most nearly ideal usage of the teeth cannot provide sufficient wear to produce a form which will serve the health requirement of those teeth. But within certain limits of anatomy, this modification of form, through functional wear, may succeed in its object.

It may be recalled here that the whole human body has a different form at different periods in each life cycle. The morphologic characteristics of the body of an infant are strikingly different from the anatomic features to be observed at any of the other developmental periods of life. And it is also equally true of the teeth that their general morphologic characteristics differ for different periods in the life cycle. Life may be said to be a succession of morphogenetic changes.

We are apt to think of the teeth as being unchangeable in form, once they have erupted. But that they do undergo anatomic change can be readily demonstrated. This change of form is of course accomplished, in the case of the teeth, through modification by wear and not through trophic increase. Their changing form is quite comparable, in its functional aspects, to the trophic changes going on elsewhere in the body throughout the life cycle, and are quite as necessary to the maintenance of functional balance. If wear has proceeded in a physically symmetrical manner, it may safely be assumed that function has been normal, and we may confidently look for health in the teeth and periodontium.

If normal wear has not taken place, it will invariably be found that there is a disbalance of occlusal function, or interference with functional use of the teeth, and, in such cases, it can almost invariably be demonstrated that disease or debility is present. This will usually take the form of evident periodontal disease. But it is quite true, although seldom mentioned, that serious pulp disturbances are also frequently found in such cases.

As the individual goes through life, the functional demands on the teeth and on their periodontal tissues are gradually changed. These demands are paralleled by internal changes in the teeth, the pericementum and the alveolar bone. In the latter especially, there is a loss of resiliency and consequently a lessened tolerance to extreme occlusal strain. These changes are accompanied by the progressive modification of tooth form, to which reference has already been made. It will therefore be found that the teeth of an individual 50 years of age will be marked by changes in form of their occluding and incising surfaces, from the form which these teeth had when first erupted. Even the teeth of a person 25 years old will be found to be

different in form from the teeth of the 12-year-old boy or girl.

These changes occur slowly, and we usually do not notice them because of their gradual development. Yet without this change, which is accomplished in the natural teeth by functional wear, an occlusal disbalance will ensue, which may be physiologic, rather than a disbalance lessening the masticatory power. And yet because it is a physiologic disbalance, it will give rise to manifest periodontal disease of a classic type. In fact, it may even be said that correct functional wear of the teeth is the most important physiologic process in the life history of the mouth.

Before leaving this phase of the subject of occlusion, I desire to call attention to the vastly different wearing qualities of the materials used in restorations, such as fillings and bridges, when compared with the natural tooth tissues: enamel and dentin. Some of the gold alloys are so very hard that they apparently resist all wear. I shall not attempt to discuss the subject of dental materials, as it would lead me too far afield. Yet this situation must be met in practice. And students of the problem of restoring lost tooth tissue and missing teeth should ponder well the subject of functional wear, and the progressive modification of tooth form throughout the succeeding periods of life.

Attention has been called by Gottlieb, of Vienna, to a phenomenon which he terms "continuous eruption of the teeth." The older belief was that the teeth, once they had erupted into a position of occlusal contact with their antagonists, did not erupt farther. The whole functional conception of dental restorations has apparently been laid down under the latter conception. Gottlieb stated, on the other hand, that further growth or extrusion into the mouth from the alveolar process does take place and is continuous throughout life.

This process goes on at a much slower rate after the tooth has met its functional antagonist, and may frequently, at some period in life, appear to be at a standstill. On the other hand, it may sometimes appear to be proceeding at a noticeable rate. It is apparently Nature's purpose in bringing about this continuous eruption of the teeth to compensate for the loss of tooth substance through functional wear of its crown, thereby preventing undue "closing of the bite" and inharmonious approximation of the upper and lower jaws, with resultant disturbance of the function of mastication.

The foregoing observations on the biologic aspects of the occlusion of the teeth have been made with the complete natural denture in mind. The functional disadvantages which result when teeth have been lost through extraction, untreated caries, etc., or have been grossly malposed, may be readily comprehended. In such cases, for one thing, continuous eruption, which because of the deformed arch cannot be compensated by functional wear, inevitably leads to traumatic occlusion. Shortcomings of teeth which have suffered such deformities are too often complacently observed by the dentist, without effort toward their correction. Individuals who suffer these physical disadvantages of the teeth and jaws may well be called dental cripples. For such people, the demands of function cannot satisfactorily be met, and the maintenance of a healthy mouth is not only beset with difficulties but is also usually not possible throughout life.

Furthermore, in mutilated mouths, in which teeth are missing, or their aline-

ment is grossly abnormal, the individual may be forced to develop muscle habits which make for physical asymmetry. These habits interfere not only with function, but also with progressive functional wear, and may become so confirmed that even when normal function is made possible by prosthetic replacement or orthodontic treatment, the patient is incapable of making proper use of the teeth. In such cases, an important part of the corrective program is the development and establishment of correct functional habit.

A study of pathologic changes in the periodontium has recently led to a consideration of apparently related changes in the tooth and dental pulp. So common has been the occurrence of certain concomitant changes in these tissues, and so nearly uniform and simultaneous has been the response of both dental and periodontal tissues to rational measures for the relief of disease, the essential unity of pathology in this tissue group is unhesitatingly affirmed.

It has been previously stated that because of the highly mechanical nature of the function of this unit, mechanical disbalance provides the dominating element in its pathology. Lack of equilibrium, as between the strength of the supporting tissues of the teeth and the work which is put upon them, brings into play the element of excessive stress. This is observed in certain instances, and in certain mouths in which teeth are loosened as the result of traumatic occlusion, and points clearly to a departure from functional form of the offending teeth.

Another less common functional disbalance is that of entire absence of occlusal stress, due to failure of the teeth to meet their antagonists. Through this lack of function, the tone of the periodontal tissues is markedly diminished in most cases, and infection is thereby made possible. In such cases, it is usually found that the periodontium suffers more than does the tooth.

In order that these changes may be comprehended and properly related, it is necessary to study the essential effects of both normal and excessive function. It should not be forgotten that stress which is normal for the teeth when the arches are in occlusal balance and each tooth is taking its functional share of the load may easily become intolerable if applied to teeth in the same position when there has been a loss of other teeth in the arch through extraction.

When normal functional stress is exerted upon a tooth, the first tissue to feel this stress is the pericementum. The effect is to produce, in some parts of the pericementum, a stretching of the principal fibers, and, in other parts, a compression of all the structural elements. The location of the portions undergoing stretching and compression will vary with the direction of the stress, the variation in the direction of stress being particularly complex in the posterior teeth. Both stretching and compression produce their effects on the blood vessels in the pericementum, the net result being a quickening of the blood flow.

When occlusal stress becomes excessive, it produces both excessive stretching and excessive compression of the pericementum. The first effect of this appears to be manifested in and about the blood vessels, with resultant disturbance of circulation. In some cases, the result of this influence on the vascular system is change in the perivascular tissues, and, in sequence with this, a resorption of the adjacent alveolar process. This group of phenomena has been

termed by Box rarefying pericementitis fibrosa.

Under other circumstances which seem to be associated with conditions which have led to the development of strong, resistant alveolar structures, the vascular changes induced by what may be recognized as excessive stress in some other individual seem to produce little if any effect in the lamina dura and the adjacent bone, but involve the blood vessels supplying the pulp. This relationship is soon to be investigated in the laboratory, as it has for some time been the subject of clinical study. The pulps of teeth falling within this category commonly show the clinical symptoms of hyperemia, which has sometimes been observed to progress to the point of stasis and pulp necrosis. In other cases, the pulp change is of a progressive character and tends to result in deposition within the pulp canal of calcic substances of various types, as disclosed by the roentgen ray, and by postmortem examination of the tooth.

Another reaction to the injurious agency of excessive stress in occlusion of the teeth is to be seen in the mouth in which there is apparently an adequate periodontal support, but in which there seems to have been deficient calcification of the tooth itself. In these cases, the effect on the blood stream in the pericementum appears again to involve the pulp circulation, resulting in a deficiency which manifests itself in increased susceptibility to certain forms of dental caries, both buccal and labial, with a coincidental disturbance in the nature of a mild congestion of the circulation in the adjacent marginal gingiva.

That this susceptibility to caries is largely internal is attested by the fact that, in these mouths, the external environment of the teeth and their surface formation is virtually identical with the same elements in mouths immune to caries. Supplementary influences in these cases are to be found in the aberration of the exudate from the gingival crevice. This is also influenced by the circulatory disturbance in the pericementum, which has been induced by overfunction.

With the exception of the disease dental caries, which usually makes its greatest inroads in the mouths of the young, the retrograde changes traceable to excessive stress, as exemplified by traumatic occlusion, are found to be associated with the lessening of resistance, which diminishes with advancing years.

As judged by conditions in the mouth, the body reaches full maturity and attains the height of its physical development at about the age of 30 years. After that age, or thereabouts, a very perceptible, but usually slow, retrogression ensues. And it is at this period of life, in the mouths of most individuals, that disease begins to manifest itself, unless there has been attained a physiologic, that is, a true functional balance of the teeth, either from natural wear or from correction of the tooth form by grinding, to provide protection against lowered resistance.

The theories stated herein are based on study and observations made during the treatment of several thousand cases in private practice and in college clinics. It has happened that many cases coming under my observation have not been cases of obvious periodontal disease, but have been referred for consultation with reference to obscure symptoms of varying kinds. It has therefore been possible to analyze mouths showing a considerable variety of conditions and to apply in those mouths the principles of occlusal adjustment which have been a part of my practice for many years. Happily, to-

day, much has been verified and confirmed by the research of others in the field of histology and pathology. But what seems at the moment to afford the greatest satisfaction is the fact that these theories as now reported, when applied in the clinic, result in the attainment of a measurable degree of health improvement for the patients so treated.

With all the necessary concentration on the treatment of disease, there has, nevertheless, been an insistent question in my mind, "How could these conditions have been prevented?" During the earlier years of practice in this field, interest centered on those cases showing symptoms of advanced disease. In those years, it was only through the presence of the most pronounced symptoms that periodontal disease was recognized at all. But as the years of practice have passed, clinical interest has gradually been developed in those cases showing less pronounced symptoms. And now, for the past few years, interest has been centering on the earliest signs and the most incipient conditions, and always with the question coming to mind, "How could even the most incipient disease condition have been prevented?"

When we speak the word "prevention," the mind reverts to the terms "oral prophylaxis" and "preventive dentistry." These two terms really mean very much the same thing. They differ somewhat as regards what they convey to various members of the dental profession. The term "oral prophylaxis" calls to mind D. D. Smith, that great exponent of dental cleanliness. Dr. Smith's method of cleaning the teeth, he termed "oral prophylaxis treatment," and he believed that the prevention of both caries and periodontal disease lay in the attainment of perfect cleanliness of the tooth surface. At the present time, we recognize prophylactic treatment, if correctly performed, as an essential part of the preventive dentistry program, but a part only. If we are to practice preventive dentistry, we must add to our armamentarium. We must give the first consideration to function, providing for each tooth that amount of functional stress which our trained observation tells us it can safely sustain. And this is what the word "occlusion" means to me: provision of a functional mechanism adapted to the strength of these teeth and their supporting structures which we find in the mouths coming under our care. When this equilibrium is provided, it will be found that a large part of the dentist's worries have been eliminated, not only as regards periodontal disease, but as regards pulp disease and caries as well.

POSTOPERATIVE STIMULATION*

By W. J. CHARTERS, D.D.S., Des Moines, Iowa

CONTRARY to popular opinion, the human teeth are among the very few that are so shaped as to prevent the excursions of food stimulating the gum marginal tissue. Nature, in her expert designing, so shaped the teeth that no harm should befall the tender tissue surrounding them. Nature, with all her power, was finally overcome when man began to cook his food, not that the rough food eaten by primitive man stimulated the marginal tissue, but the chemical reaction of the modern diet produces weakened soft-tissue conditions, where putrescence abounds, and micro-organisms thrive and deal destruction to underlying structures. It is this condition which makes necessary a plan of artificial stimulation.

There are approximately 50,000 dentists in the United States, of whom 99 per cent are practicing restorative dentistry, and 1 per cent systematically teaching preventive dentistry. Now, it is reasonable to presume that, in people over 20 years of age, there are as many defective oral conditions due to pyorrhea or gum trouble as due to decay. I am unable to state the cause of laxity of attention to gum disorder by the dentist. It is possible to prevent practically all of this trouble arising in alveolar process and gum, and a large percentage of cases of decay, mechanically. Therefore, are our patients not entitled to this service? The germs which cause these mouth ills require putrescent food in which to thrive abundantly. It is impossible to annihilate these tissue-destroying micro-organisms in the mouth with the stongest medicinal agents we can safely use on living tissue. Starvation of these micro-organisms is the best means to use, and as there is no acid which can be safely used to remove the mucin, we are obliged to remove by friction all putrescence on and around the teeth. For this purpose, a properly shaped toothbrush is the best instrument that I know of.

In addition, a slender piece of wood or metal made to go between the teeth to stimulate the soft tissue will serve to correct the conditions under which the bacteria thrive.

Postoperative treatment is divided into three classes: (1) prophylaxis; (2) curetting; (3) gum excision.

CLASS ONE

After scaling and polishing has been completed, which usually requires one or two sittings, the patient is instructed to return in two or three days bringing two toothbrushes, one for home work and the other for office treatment and instructions on the home care of the gums and teeth. When the patient is placed in the chair and the dress covering is adjusted, the conversation with the patient is as follows: "You have had,

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and have been treated for, beginning pyorrhea, which was largely brought on by your method of caring for your mouth (gums and teeth). Now, unless your method is discarded, your gums will be in the same or a worse condition than they were before your periodontia treatment. If you will agree that a healthy mouth is worth many times more than the little effort which you will be required to put forth at home, you will try hard to learn the proper method and use it."

The dentist starts the work. He takes the pliers and a small pellet of cotton, which he dips in a disclosing solution, (iodin, 10 per cent) and with which he paints the teeth. Then, gently spraying the teeth, he allows the patient to look in the mirror. If any iodin coloring remains on the teeth, the patient is told that that is dirt, and that he has not been reaching those surfaces. The disclosing solution and nothing else will convince the average patient that his teeth are not clean. To remove this dirt or mucin, a coarse abrasive is required. The dentist uses a glass or paper slab and places thereon any good tooth paste or tooth powder, incorporating fine pumice, cuttle fish and, in extreme cases, fine carborundum powder. Next, he moistens a stiff bristle brush under the tap, and dips it into the paste on the slab; then carries it to the mouth, and proceeds to force the bristles between the teeth as far as possible, trying to keep a considerable amount of pressure on the gum margin with the sides of the bristles, and moving the brush elliptically. After three or four oval motions have been made, the dentist removes the brush from between the teeth and reenters the same location, doing this three or four times. He then moves the distance of one tooth and goes through the same series of friction and stimulation until he has completely encircled the upper and lower teeth, finishing at the point whence he started. This will have consumed about ten minutes.

Next, the gum stimulators are brought into play. These are made of wood or metal (copper, silver or gold) and shaped somewhat like a toothpick. They are inserted between the teeth far enough that the point may be felt by the tongue. Considerable pressure is created on the gum margin. Each interdental space is cared for. This process consumes another two minutes. In the case of severe congestion, a bud-shaped wood or aluminum compressor in a porte polisher is used, bucally, labially and lingually, making the congested blood flow freely. After two to four minutes in this work, the use of the instrument is discontinued, when most of the congestion has been eliminated.

Now, the patient is given the brush and instructed as to how to place and manipulate the bristles on the upper and lower, outside or labial surfaces of the anterior teeth only. At the first sitting, the patient is taught only what can be remembered until the next sitting. This is to prevent confusion, and the patient will be more liable to remember this lesson. The patient is given a bottle of the disclosing solution to use at home. This completes the first sitting, and the patient is instructed to return the next day for the second brushing and lesson, at which time a new location is taken, the work progressing at each lesson until the entire mouth is covered.

The disclosing solution is brought into play again to show the patient how many places he may be missing. The usual time is consumed in the brush treatment and lesson. This procedure is carried on for about a week. The same lesson is carried on through the second week, only

every other day, and if the patient is sufficiently eager to learn this method thoroughly, he is allowed to return as often as he wishes or until he has mastered the art of manipulating the toothbrush so as to stimulate the gums and clean the teeth correctly. Should the gums be pierced by the toothbrush, which is usually about 2 to 3 mm. from the gingivae, the injury should be treated by phenol 95 per cent. This is done by dipping a small pellet of cotton about the size of a pinhead in the acid, and carrying it to the injury for cauterization. No matter how sensitive the places may be, they are made comfortable almost immediately by this treatment. Should canker sores be present, the dentist should treat them in the same way, using concentrated nitric acid instead of phenol. I do not hesitate to make the statement that if the patient will continue to use the toothbrush and gum stimulators, which may be made of wood such as the common toothpick, he never need fear the ravages of periodontal disease provided traumatic occlusion has been corrected and systemic conditions are not too irritating.

CLASS TWO

Where scaling of the teeth or curetting of the process is necessary, the treatment is the same as in class 1 cases.

CLASS THREE

These are advanced cases in which removal of a portion of the gum was necessary. A dressing of "wondrpak" is placed between the teeth and allowed to extend over the excised edge, or a thick mixture of oxid of zinc and eugenol covered with thin strips of paraffin may be used. The dressing is left on from a week to ten days. The patient is instructed to return for another dressing if the dressing should be accidentally dislodged too soon. When the dressing has been permanently removed, light stimulation with the brush should be commenced, and the pressure increased at subsequent sittings, or as soon as the gum permits more effective stimulating. The mouth should be sprayed with an antiseptic lotion before and after brushing. An extra amount of spraying should be done when insoluble abrasives are used. Since a rough edge of process greatly retards the formation of new soft tissues, this edge should be made smooth.

BRUSHING VS. STIMULATION

The question asked by almost every patient is, "Doctor, how often should I brush my teeth each day?" The answer, "It is not the number of times that is important, but how well it is done." Time should not be spared while the toothbrush is in use as it takes much longer to stimulate the gingivae than is required to clean the teeth. A sand glass might well be used to measure the time spent. Do not at any time say to yourself that you are going to brush your teeth. Think that you are going to stimulate the gum margin especially between the teeth. It is impossible to do that without cleaning the teeth. On the other hand, the teeth can be made reasonably clean without creating pressure on the soft tissues. The expression "brush the gums" should not be used, as this action necessitates using the points of the bristles. Contrary to this method, my technic stimulates with the sides of the tufts.

On whose palms will the epidermis be the more resistive, the bookkeeper's or the bricklayer's? The latter's, of course, owing to the heavier class of work that he does. Only a 3-ounce pressure can be made with the points of the bristles in a sweeping motion, and a pressure of

5 pounds can be produced with the sides of the bristles in a wedging position. Actual tests have been made to prove this statement. Some of you will be curious to know why the 5-pound pressure is required. Compare the interdental tissue in the mouth in which high pressure has been used with that in the mouth in which only a 3-ounce pressure has been used. Again, a few may believe that the heavy pressure may drive the soft tissue away from its present position. Remember that we are using intermittent pressure, and, with this, it is absolutely impossible to change the position of the soft tissue, after we have brought it to normal thickness over the alveolar process. Dental floss will not produce resistance in gum tissue. As it enters between the free gum margin and the tooth structure, it therefore should be used only for removing fibrous material from between defective contact points. There is no medicament known that will develop resistance in tissue any more than absent treatment will. Heavy intermittent pressure is the means of making tissue hard. Therefore, all concave surfaces between the teeth should be eliminated so that the stimulating instrument may come in contact with the complete interdental surface.

The most important tissue to be stimulated and cleaned is so situated in the mouth that a sweeping movement of the brush will not touch it. Hence, the necessity of employing the technic which I advocate. Ninety per cent or more of adults have periodontal disease, and are brushing their teeth as the children are being taught in our schools today. I wish to repeat the statement which I have made many times, that it is impossible to teach an adult or a child how to make the tissue clean between the teeth from the platform or by toothbrush drills. Personal demonstration is the only way to make it clear.

I suggest the brushing of teeth before bedtime. We all agree that brushing before breakfast is necessary, and you all agree that we should brush after meals, and before retiring. It would appear that you were guessing or that you were not sure which was the proper time to brush. Now I do not know of any harm from brushing both before and after meals, on account of the stimulation that is required, but I do think it unwise to contradict ourselves. How many of you would like to eat from dirty dishes? Then why should we masticate with dirty teeth? There will be as much mucin deposited on the teeth in five hours whether we brush before or after meals, and the reason for using the toothbrush as far as the teeth are concerned is that we wish to starve the bacteria.

Let all dentists acquaint themselves and their patients with the proper method of caring for the teeth, and we shall do a genuine service for the health and comfort of our fellow men.

DISCUSSION

M. L. Drake, Cleveland, Ohio: In the second paragraph of Dr. Charters' paper, he says, "It is possible to prevent practically all of this trouble in the alveolar process and gum and a large percentage of decay, mechanically." You will say, "That is almost dentistry's ideal." I can reply, after three years' experience, "Dr. Charters is right. Nothing has carried our patients so far into the realm of prevention and healthy mouth conditions as the Charters brushing system." In the following sentence, Dr. Charters says, "I am unable to state the cause of laxity of attention to gum disorders by the dentist." Now that is not hard to explain. I have been around a dental office almost constantly for about thirty years, and each and every year the dentist has been approached with a sure cure for pyorrhea. You all know and have tried many of them. You will remember epicac (emetin), prescribed locally and hypo-

dermically, the roentgen ray, ultraviolet light, the actual cautery and myriads of drugs, such as iodized phenol, copper sulphate; acriflavine, sodium hyposulphite and trichloracetic acid. Is it any wonder the dentist is skeptical when you say, "Use a toothbrush as Dr. Charters directs and your pyorrhea worries will be reduced 70 per cent." So I urge you to learn this brushing technic and you will take home with you the finest thing for your own mouth health (as well as your patient's) that any convention ever gave you. You can learn it only by a "hand to mouth" demonstration. It is extremely difficult to get it from a written description. You must see it demonstrated and get the "feel" of it in your own mouth. This technic not only cleans between the teeth but also stimulates the gum tissue by massage. You may have a little difficulty (as I did) in explaining the excellent results gained by this toothbrush massage, in the light of sound physiologic principles. But when you see marginal, and especially the almost universal interproximal, gingivitis (in adults) clear up in three weeks or less time, you will be convinced of its efficiency. The cleanliness of the interdental spaces will be a revelation. Dr. Charters has shown by bacterial count studies on a succession of fifty cases that the bacteria were reduced 90 per cent by his system. Regardless of the severity of the periodontoclasia, after forty-five minutes of prophylactic work, we start our patients on the Charters technic. Then, in two or three weeks, the tissues are ready for deeper gum and root surgery. The gums do not bleed profusely, and the removal of the remaining serumal calculus is efficiently accomplished. If curettage or gum excising is indicated, conditions for a favorable result are now present. Congestion and cellular infiltration have been dispelled. There is a normal arterial blood supply. The lymphatics are not engorged with toxic products or bacteria. Of course, traumatic occlusion is relieved, and the dentures placed in as perfect balance as possible and harmful diet practices corrected. But Dr. Charters' system must be instituted to complete the chain and is the most important link.

I. S. Miller, Jersey City, N. J.: Just how often should teeth be cleaned? The patient asks, "How frequently shall I change my brush?" What does Dr. Charters advise his patients in that connection?

W. B. Clotworthy, Knoxville, Tenn.: I would like to ask Dr. Charters what he does to gain the interest and attention of his patients in order to demonstrate his way of brushing. It has been my experience that you cannot get some patients to look in the mirror while you are demonstrating. It is hard to gain their attention and drive the point home.

H. S. Daniel, Mexico, Mo.: Do you advise the use of a wet or a dry brush?

S. B. Luckie, Chester, Pa.: I would like to have an expression of opinion as to the character of the brush that is used; whether with a short bristle or a long bristle. The healthiest mouth not having the care of a dentist that I ever saw was that of a man who used a nail brush for a toothbrush, and, as you know, the bristles of a nail brush are very short. He had beautiful gums.

H. D. Rodnick, New York City: I should like to know Dr. Charters' opinion of mouth washes.

Member: I should like to inquire as to what Dr. Charters recommends or the method he uses or suggests to his patients for sterilization of their toothbrushes.

Member: I should like to ask Dr. Charters if he recommends a paste or a powder, and if he prefers either, why?

Dr. Charters: How many times a day should the patient brush his teeth? Usually, four times: before meals and before retiring. How long should we use a toothbrush before purchasing a new one? That depends on whose hands it is in. I have used two toothbrushes in nine months. That is four and a half months to the brush. The average patient abuses a toothbrush. The more they become accustomed to this method, the easier they are on the brush and the longer it will last. Usually about a month. Should the brush be dry or wet? Wet. This brushing requires developing the sense of touch through its entirety. If you start with a dry brush, in a few seconds, it is wet. The bristles are weaker than when you started. Then you have to change your pressure. In other words, a lighter pressure is necessary; so strike a happy medium; as it is wet a few seconds after you start, start with a wet brush always. Powder or paste? Either. How to create interest of the patient in this work? Anything that we get for nothing does not amount to anything. If we are paying for it, it is worth a lot. Charge, by all

means, for this work, and after the first two or three days or a week, the patient becomes intensely interested. Long or short bristles? The longer the bristle, the better for this method, in the hands of those who can use it correctly. As to mouth washes, we must use an abundance of water, at body temperature, to rinse out the mucin, after we are through brushing, as the toothbrush removes very little of the mucin from the mouth. Then we can finish by using a strong mouth wash. As to sterilization of the brush, each brush, after being used in the office, is washed under the water tap and dried by an electric fan, with a small heater attached, then placed in a glass cabinet. That is all the sterilization that brush gets in the office, as bacteria need moisture in which to thrive. The patient should take care of the brush just as it is taken care of in the office. Wash under the water tap, and then allow to dry. Do not use salt. Salt is a moisture collector, keeping bristles wet instead of dry.

J. D. Towner, Memphis, Tenn.: How many brushes would you advise the patient to have at any one time?

Dr. Charters (closing): It is not necessary to have two toothbrushes, if you are starting with them moist. After they have become weakened so that they cannot create considerable pressure, a new brush should be procured.

THE ECONOMICS OF PERIODONTIA*

By ARTHUR H. MERRITT, D.D.S., F.A.C.D., F.A.A.P., New York City

BACK of the economic problems of periodontia, and to a considerable extent responsible for them, is another problem the solution of which must precede and prepare the way for a consideration of those problems of a purely economic nature, as the one cannot be solved independently of the other. The latter is a problem in education having two angles: one including the dental profession, the other, the public. Perhaps this dual nature of the subject can best be illustrated by referring to a question which a dentist practicing in a small city recently asked me; namely, "How is it possible to practice periodontia in a community where every other dentist cleans teeth for a dollar and a half?" In harmony with this question, I am frequently told by dentists that it is impossible for them to give any consideration to periodontia in their practice, as their patients will not pay for it; that to them, such treatment represents simply cleaning the teeth, and that patients will not pay for such service. From this, it will be seen that ignorance of the nature, scope and purpose of periodontia is primarily responsible for the whole problem. It will also be evident that, in the solution of this educational problem, there are two factors to be considered: (1) the education of the dentist whose notion of periodontia is indicated by his willingness to clean teeth for a dollar and a half, and (2) the education of the public to a realization that dentistry is not to be thought of in terms of fillings, bridges, plates, etc., that can be purchased at so much a piece or so much an hour. Education is what is needed to correct this situation; first, education of the dental profession to a realization of the important part which it must play

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in the solution of this problem, and, through it, the education of the public. Knowledge is the only antidote for ignorance.

The responsibility for this undertaking rests squarely on those of the dental profession who have come to realize the important part which periodontia plays in the practice of modern dentistry, and who know from experience its value in the prevention of all dental diseases. In other words, those who are at present engaged in the practice of periodontia must take the lead in spreading the gospel of oral hygiene and periodontal health among those in general practice (as is being done in this symposium), in order that the family dentist, on whom the public naturally depends for the solution of all its dental problems, may understand that periodontia is not just a matter of cleaning teeth. And then, assisted by their converts, the public in whose interest the entire educational campaign is conducted, must be made to realize that it is not periodontal treatment that is expensive, but the lack of it; that where prevention and treatment of periodontal diseases costs dimes, neglect, with its sequelae of ill health and artificial teeth, costs dollars. The American Academy of Periodontology, in the realization of its responsibility in this matter, has, through its publicity committee, prepared a long series of popular articles covering not only every phase of periodontia, but every aspect of preventive dentistry as well. These have been designed for publication in the public press and are available to any one wishing to make use of them. As a means for educating the public, they are unique. They have been made use of in nearly every state in the union and in many foreign countries.

The most effective way in which to educate the public in dental matters is by word of mouth. When the patient presents himself at the office of the dentist, it is the duty of the latter to instruct him in the ways and means by which most of the dental diseases to which he is subject may be prevented. This, of course, cannot be done by the dentist whose idea of periodontia extends no farther than cleaning of teeth for a dollar and a half. The stream cannot rise higher than its source. In many respects, that part of the public which now patronizes the dentist, proving thereby that it is interested in dental health, is, in its ideas of prevention, already in advance of the dental profession. More and more is the public demanding that reparative dentistry give way to preventive dentistry. People do not permit their teeth to become involved in periodontal disease because they are unwilling or unable to pay for proper treatment, but because, in too many instances, the family dentist has not realized their needs in this respect until disease of a more or less advanced stage has developed. In too many instances, also, he feels that he has discharged his obligations in these matters when he refers the patient to the dental hygienist, who, by training and experience, is wholly unfitted to care for such cases; all of which emphasizes the educational aspects of the problem.

But, as already indicated, there is an economic side to the question. No service is free: somebody must pay for it. If the recipient does not, the donor must. There are three classes of patients to be considered in the practice of periodontia: those who are able to pay little or nothing; those who are able to pay any reasonable fee, but who may be unwilling to do so, and, finally, those who are both able and willing to pay. The dentist should always be ready to do his share in caring for those in the first class, especially

those who are able to pay something, showing thereby that they are deserving of such consideration. No one engaged in the relief of human suffering should ever refuse his services because the patient is unable to pay his fee. There are few if any clinics to which such patients can go for periodontic treatment. For this reason, one is under more than the usual obligation to do what he can to meet this situation by being willing to make his fee such that, within certain limits, he can care for his share of such cases. Those in the second class belong as a rule to those who need to be educated. If they can be made to understand that, simply as an economic problem, neglect costs more than treatment (which it always does), they will be among the first to demand treatment. The desirable patients are those to be found in the third class, who are both able and willing to pay. This class should be made to pay for treatment such fees as will make possible the care of a certain number of patients who may be just as worthy, but who cannot pay more than a fraction of the cost. When such treatment is honestly and efficiently given, the patient will always get his money's worth no matter what the fee may be; there will be no danger of his being overcharged.

Periodontic treatment need not be expensive, and in preventive cases, never is. Occasionally, one hears of the large fees some one is reported to have charged, and the impression goes abroad that "pyorrhea treatment" is expensive. This is not true. There are few cases that require more than a few hours of treatment, and the cost per hour is always less than that of restorative treatment when the cost of supplies has to be considered. Moreover, the cost of treatment can always be reduced by the application of efficient methods. The individual who, by the employment of such methods, can do in one hour what another requires two hours to do has, other things being equal, cut the cost of that operation in half no matter what the fee may be. Indeed, he may charge a fee per hour twice that of his colleague and, at the same time, be the less expensive of the two, for the cost of time, transportation, wear and tear, etc., have also to be considered. Unfortunately, if he quote fees at so much per hour, he will be placed in the position of appearing to the patient to be twice as expensive, which is only one of the reasons why such fees should never be quoted. In furnishing the patient with an estimate of the cost of a given case, one will need to bear in mind the probable amount of time required in treatment, and the value of one's time, which will be largely governed by the demand made on it, and then quote a fee for the completed operation.

Many patients uneducated in such matters are in the habit of thinking of dental fees in terms of hourly charges, a situation for which the dental profession is largely responsible. If all were of equal skill, and could accomplish the same results in the same time, this might be a satisfactory way in which to estimate fees, but since this is not so, and, by the very nature of things, cannot be, one should learn through the application of efficient methods to render the maximum of service in the minimum of time, and then charge for the service rendered, not for the time consumed. Only by such methods can economic justice be done to all concerned. Unfortunately this is not always done. There is a vast amount of inefficiency in the practice of periodontia. This is due to temperament, unfamiliarity with the fundamentals of treatment, faulty technic in instrumentation, etc. There can be no doubt that inefficient

methods explain most of the cost that may be regarded as excessive in periodontia. There are, of course, a few commercially minded individuals who add to this by excessive fees, but inefficiency and excessive fees do not necessarily form a part of the practice of periodontia. When practiced efficiently and honestly, periodontic treatment need not be beyond the reach of any patient.

As a rule, it is desirable, in most communities, to inform the patient, in the first instance, of the probable cost of treatment. Since time is an important factor in cost, and as it is not always easy to estimate the amount of time required in the treatment of a given case, it is usually wise to quote a minimum and a maximum fee. If, for example, one regards his time as worth $10 per hour, and it is believed, after careful examination, including a roentgenographic examination, that it will require ten or twelve hours in treatment, a fee of from $100 to $150 can be quoted. As there are relatively few cases requiring ten hours, if treated by efficient methods, it will be obvious that, when compared with restorative treatment, the cost is not great, no matter what one's fees are.

But the most efficient and the only wholly satisfactory solution of the economic problems of periodontia is to be found in the prevention of periodontal diseases. When the dental profession and the public realizes that the advanced case of periodontoclasia, requiring hours of time in its treatment, had its origin in a simple and unnoticed lesion in the gingivae which might have been prevented from further progress in one treatment, and applies the lesson so learned, it will have solved once and for all the economic problem of periodontia.

580 Fifth Avenue.

DISCUSSION

Carlos H. Schott, Cincinnati, Ohio: There is no one better fitted in the dental profession than Dr. Merritt to treat in a dignified way the subject of economics. It is really most inspiring to hear a man who has an ideal treat the subject of economics in a really professional manner. I should like to emphasize one point that he has made and that is that dentists, whether general practitioners or specialists, must be educated to practice periodontia as a health service. We, as periodontists as well as general practitioners, must encourage the dental colleges of the country to complete the subject of periodontia, as the fundamental of all dentistry. Until this is done, we will never make the advance we should. We must emphasize its economic value and command a fee commensurate with the service.

Justin D. Towner, Memphis, Tenn.: The chief deterring influence on one who contemplates the practice of periodontia seems to be the matter of economics. The problem this presents will not be solved until one is first convinced that such service is essential to mouth health and, therefore, worth the effort. Then, and only then, can such practice become an economic asset to either the dentist or the patient. Our first and last obligation, as I see it, is to be fair with those we serve. If we do this in the matter of health service, satisfactory compensation will follow. Since Dr. Merritt did not emphasize fees, I take advantage of the opportunity to emphasize one answer to this question which is uppermost in the minds of so many contemplating such practice. A definite approach to the problem as to how to convince oneself and patients that certain fees are necessary is this: Divide any contemplated fee into two distinct parts, one being hospital expense, which in this case is the overhead; the other, that of personal compensation. An explanation should be made to the effect that a surgeon, when called on to operate, sends a patient to the hospital, and that any fee that he may name is a personal one, and hence only a part of the expense incident to that particular service; that payment must be made for room, nurse, anesthetist, operating room, drugs, etc. When it is clearly understood that dental fees include all operating facilities, plus personal effort and skill, adequate compensation may be named without contention on the part of patients. Certainly

no one will object to contributing his portion of the expense essential to office maintenance and few will permit a personal service without some compensation.

C. C. Sherwood, Toledo, Ohio: It seems to me, as I talk to men in our section of the country, that they fail to determine what it costs them to produce on the aggregate so many hours per year. In failing to do this, they fail to estimate what costs are, and are unable to determine what fee to charge. This varies in different localities, and it seemed to me in the question of economics, if every man as a specialist or in general practice, would figure his costs, he would have no difficulty in regulating the fee that he might charge the individual patient.

James M. Gray, St. Louis, Mo.: Some time ago, I listened to an advertising man trying to sell a group of business men some advertising for a certain product. In his sales talk, he quoted several things that impressed me with the idea of trying out various sales methods in my own line. I listened to this advertising man as he told how he conducted the advertising business. Several plans would be tried for the same article. He mentioned, in some instances, having tried about twenty for the same article. Two out of these twenty proved to be money getters. Experience has taught him that this is the only way of arriving at a definite method. In my own office, I have tried various methods of getting the proper fee for my services and at the same time retaining the good-will of my patients. I have tried Dr. Towner's suggestion and also Dr. Merritt's. I might offer this as a suggestion for a method that has proved most successful in my own office. I count the number of teeth to be treated. I try to determine the amount of work necessary to treat the number of teeth and state a price per tooth. This has been most satisfactory in my own office, as patients take kindly to this basis for determining fees. Dr. Towner suggested having a hospital fee. This would be fine with a certain class of patients, but would scarcely do as a routine practice.

Dr. Merritt (closing): The only wholly satisfactory solution to the economic problem in periodontia is prevention. And may I say to you as a group of family dentists on whom the public depends for all its dental needs that the responsibility is largely yours; that if you will learn in daily practice to recognize the early symptoms of periodontal lesions and take such measures as are necessary to prevent their development, you will have entirely eliminated the economic problem in periodontia and to a large extent that of dentistry also.

ETIOLOGY OF CLEFT PALATE AND CLEFT LIP AND SOME FUNDAMENTAL PRINCIPLES IN OPERATIVE PROCEDURE*

By CHALMERS J. LYONS, D.D.Sc., Ann Arbor, Mich.

DURING the past two score of years, volumes have been written on the subject of cleft palate and cleft lip, until it would seem that the subject has been well exhausted. Each writer has emphasized his own personal technic and theories, showing by illustrations his successes, but omitting some of the miserable failures which all of us doing much of this type of surgery frequently have.

After more than twenty years' experience with this deformity in a large clinic where we see not only our own failures but also the failures of other experienced men doing this work, the question arises whether or not too much emphasis has

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not been placed on technic, some of which may not be wholly sound, with the result that some of the important fundamental principles have been overlooked.

It is with this thought in mind that I shall attempt to confine the paper to a few notes on the etiology of the deformity and a brief discussion of the fundamental principles to be considered in the operative procedure in cleft palate and cleft lip.

The etiology is obviously obscure. Many theories have been advanced as to the causative factors in this deformity, all of which seem to meet with some objections.

PREDISPOSING CAUSES

There are certain predisposing conditions which we believe have their influence on this deformity. The first that may be mentioned is heredity. Just what the hereditary causes of the deformity are is not very clear. There seems to be something in the germ plasm of one or both parents that inhibits fusion of the embryonic processes at a definite time when normal fusion should have taken place. This inhibition may be partial or complete, which accounts for the different types of the deformity. We see many cases in which it appears fusion has been delayed beyond the time of normal fusion of the embryonic processes and a prenatal scar results simulating a postoperative scar.

It is very difficult to obtain a complete and authentic family history in cleft palate cases. Either the members of the families who are interviewed do not know or they attempt to conceal the facts. It is my opinion that if we could get a complete family history, going back far enough, we could trace cleft palate and other congenital deformity somewhere in the immediate family, or its collateral branches. In those cases in which we are able to get quite a complete family history, this deformity seems to follow pretty closely the hereditary laws of Mendel.

This deformity seems to be associated quite closely with other deformities of the body. These other deformities may or may not be present in the parents or grandparents, or a cleft may exist in one member of the family and other deformities in other members. A striking example of such deformities is furnished by Haight,[1] who reports a Malay family of seven children born within ten years and all dying in infancy, only one of which was without external malformation. The six children presented the following deformities: (1) absence of cartilage of left ear; (2) double cleft palate and harelip; (3) absence of the left forefinger; (4) absence of left great toe; (5) dermoid of neck, and (6) occipital hydrencephalocele.

Supernumerary teeth are considered by Warnekros[2] of Berlin as a cause of cleft palate. There seems to be a very definite relation between supernumerary teeth and this deformity. We are unable to associate supernumerary teeth, as a causative factor, with cleft palate. The cleft of the lip cannot be dissociated from this deformity, and certainly the presence of supernumerary teeth would have no influence on the cleft of the lip. Then, too, we frequently find clefts of the lip with a normal palate. It is my opinion that the causative factor of one must be the causative factor of both. The fact that in many of these cases of cleft palate and harelip supernumerary teeth are present does not necessarily mean that

1. Haight: Remarkable Series of Infantile Malformations, London: Lansett, 1895.
2. Warnekros: Die Enistehung der Haserscharte, dis Wolfsrachen und dis hintern Gauminspaltens.

the teeth were the cause of the cleft. Whatever influence the supernumerary teeth might have must be exerted before the time of the closure of the maxillary and nasal frontal fissures, which takes place at a period considerably earlier than the time when the dental ledge first shows an indication of separate tooth papillae.

EXCITING CAUSES

In the early literature on this deformity, maternal impressions have been given some significance as an exciting cause. After obtaining histories of more than 3,000 cases, we have not been able to obtain any authentic history that would lead us to believe that maternal impressions were even remotely connected with the deformity. In a large number of the cases, the mother will give a history of hearing or seeing something long after the time when the several processes would have been united. Malnutrition is another factor that has been given some consideration, yet in no way has it been proved either in the human family or in animal experimentation that malnutrition may produce this deformity. Several animal experimentations have been carried on, in Berlin and London in the zoological gardens, on lions and jaguars in which fresh meat without bones was fed to the animals, and in these cases many of the offspring had cleft palate. Sir Arthur Keith, an officer of the London Zoological Garden, has stated that it was true that lion cubs born in the Garden frequently had cleft palate, but that careful experimentation, both with food and water, failed to show any relationship between the mother's food and the occurrence of the defect.

This deformity may also occur in dogs. I have had occasion to observe a litter of ten puppies in which nine of them presented this deformity in all of its different phases. On inquiry, I found that the mother dog was not fed or cared for any differently than she had been on previous occasions.

We have been unable to find a single case in our clinics in which the mother's food would give us the impression that it was even a remote causative factor. Among the exciting causes might be mentioned amniotic bands and adhesions. Broad adhesions of the amnion are present in most severe facial malformations.

Brophy[3] mentions tongue pressure as a possible exciting cause. He states that, in early embryonic life, between the second and third months, the tongue fills the whole mouth. As late as the later part of the second month, it is much thicker than at birth and is kept between the hemispheres of the maxilla. In the young infant, it is almost constantly thrust up between the dental plate and into the nasal palate. This condition cannot be considered as one of the causes, for the reason that several cases have been reported of cleft palate and harelip in which the tongue was so small that only the tip of it was visible. Consequently, it could exert no pressure on the embryonic processes of the maxilla.

The crowding of the maxilla apart by the mandible as soon as the muscles of mastication become active may bring pressure on the palato-alveolar inclined parts of the ununited maxilla and may act as a wedge to increase the separation, which widens the breach. The flexed position of the head with the symphysis of the mandible resting on the sternum contributes to some extent to the force which is exerted by the mandible on the palatal arch.

3. Brophy, T. W.: Cleft Lip and Palate.

Foote[4] believes that cleft palate is a local evidence of a general faulty development of the osseous system and shows that there seems to be a difference in the osseous structure of not only the maxilla but also the long bones in these cases. It is a clinical fact that orthodontists have found it more difficult to treat the jaws of cleft palate children than to treat normal cases. The process of osteogenesis does not seem to be so active.

This deformity occurs in all nationalities and climes and in all social strata of life. While statistics are not always authentic, we believe with our present knowledge that the deformity occurs in about one to 1,200 births. It has been thought by some that it is endemic, that is, peculiar to certain districts or localities. This knowledge has probably been gained through the fact that certain localities seem to furnish more of these cases than others. I am of the opinion that the fact that certain nationalities inhabit these localities is the greater factor in the occurrence of cleft palate and cleft lip than climatic conditions.

Frazer[5] made a study of the occurrence of this deformity and attempted to compile some statistics. The data, while very interesting, are not sufficiently voluminous to warrant definite conclusions. There are certain nationalities which seem, from the data that we have, to be more predisposed to this deformity than others. In his studies, Frazer reports more cases among the Finnish people than among other nationalities. Our own observations are in accord with his findings. Intermarriage, undoubtedly, has its influence on the occurrence of the deformity, particularly when intermarriage occurs in those nationalities in which the deformity is most frequent. James O. Beavis, at the University of Michigan, in a study of a large number of cases, has compiled the following interesting statistics:

Males affected (per cent) 52.6
Females affected 47.4
Unilateral cleft of lip on right side. 40.0
Unilateral cleft of lip on left side.. 60.0
Family histories revealing cleft palate and cleft lip in immediate family 17.5
Cases of enlarged thymus as shown by roentgen ray 60.0
Congenital defects associated with this deformity 19.8

The congenital defects which may be associated with the deformity as given by Brophy are: hydrocephalus, inguinal and umbilical hernia, polydactylism, syndactylism, hypospadias, curvature of the spine, spina bifida, absence of one eye, absence of premaxillae, macrostoma and angioma.

With our present knowledge of the etiology of the deformity of cleft palate and cleft lip, it is not within our power to prevent it as we would prevent disease, but we can, I believe, so improve our operative procedure in these cases that practically normal individuals may be restored to society. All of our operative procedures should have just one thing in mind, that is, not merely to close the cleft in the palate or lip, but also to place all of these misplaced tissues in their normal position.

The goal at which the operator of cleft palate and cleft lip should aim is normal function. Unless the palate and lip are put in a condition where normal function may be obtained, speech will always be imperfect. In order to understand the

4. Foote, J. S.: Cleft Palate as a Local Evidence of a General Faulty Development of the Osseous System, J. A. D. A. 8:1025 (Dec.) 1921.

5. Frazer, J. E.: Occurrence of a Cleft Palate, London Practitioner, 49:401, 1917.

many requirements that are demanded of a surgically restored palate, one must fully understand the mechanism of speech and particularly the part that the soft palate plays in phonation. The velum palati is always destroyed by the cleft, and it should be restored to its normal position, if perfect phonation is to be expected. The operation must furnish physical means by which the muscles may be trained to perform involuntary acts which occur normally in the production of articulate sounds and the resonating tone quality of the voice. It would be safe to say that a successful operation for cleft palate and cleft lip will only be a part of the big problem of restoring normal speech.

In order to understand just what has occurred in this deformity, and to know the extent of deviation from the normal in these cases, one should know the normal mouth and lip. The mouth is surrounded by a very complex muscle, the orbicularis oris. This is not, as is sometimes thought, a single muscular band surrounding the mouth which is simply divided in the case of a cleft lip, but is made up of a complicated interlacement from many sources. The fasciculae of the muscle run in quite different directions and, at the lower angle of the mouth and in both upper and lower lips, are intimately connected with fibers of practically all of the facial muscles. Some of the fibers of the buccinator muscle actually go in the same direction as the fasciculi of the orbicularis oris. In addition to all of this complex mechanism, this muscle possesses sagittal and vertical fasciculi which form a small slender muscle situated along the midline of the upper lip with its insertion into the cartilaginous nasal septum. This portion of the muscle is always deviated from the normal in cleft lip. On account of the complicated structure of this muscle, it is very difficult to get all of the fibers in their normal position in the closure of a cleft lip. As a consequence, normal function is frequently lacking after this operation. This is observed when the patient smiles. Richie has pointed out, in case of the double cleft lip, that there are no muscular fibers in the portion of the lip covering the premaxillary process. It is thought by some that this portion of the deformed lip should be used to help to restore the columella of the nose instead of being used as a part of the lip. Further study of the deviation of the orbicularis oris muscle in this deformity should result in better operative procedure.

We will all agree that the primary excuse which we have for operating on a cleft palate is the hope of establishing good phonation. When an operation fails to do this, it cannot be said to be successful. How often do we see cases in which the cleft palate seems to be closed yet speech is not improved in any perceptible degree. In these cases, we have failed to restore the soft palate to its normal position. We must understand thoroughly that a successful operation for the palate must include more than merely bridging the mucoperiosteum and mucous membrane over the cleft. Unless the operation furnishes physical means by which the muscles of the palate may be trained, the operation is a failure. In order to understand the physical means of phonation, we should be familiar with the normal palate. A brief review of the anatomy of the normal soft palate, perhaps, will not be out of place in this discussion.

The soft palate consists of a fold of mucous membrane, continuous with the hard palate, enveloping several layers of interlacing muscular fibers. It is concave

on each side and presents at its midline the azygos uvula, which varies from a short prominence to a structure 2 cm. in length. In some individuals, the azygos uvula may be absent; in others, it may be bifurcated. When the mouth is closed, the palate and uvula rest against the tongue; when open, they hang free. The soft palate can be elevated so as to come in contact with the back of the pharynx; which closes all communication between the nose and the mouth. This part of the anatomy is very important in the operation for cleft palate. There are five important muscles of the soft palate that must be taken into consideration in cleft palate surgery; all having a function in phonation.

MUSCLES OF THE SOFT PALATE

The tensor palati muscle arises from the scaphoid fossa at the root of the temporal process, from the spine of the sphenoid and from the outer membranous part of the eustachian tube. It descends vertically along the internal pterygoid plate as a round, red and distinct muscle. It becomes tendonous as it turns inward under the hamular process at right angles to its previous course, after which it broadens into the area of fibrous expansion in the soft palate. Its action is to render the palate tense and dilate the eustachian tube.

THE AZYGOS UVULAE

It is thought by some that the azygos uvulae originally is a double muscle and at birth becomes practically a single one in the normal child, but remains double in cleft palate. It arises from the tendonous fibers of the tensor palati, and appears as a projection downward from the soft palate. Its action is to aid in deglutition.

PALATOPHARYNGUS

The palatopharyngus has a complicated origin in more than one layer from the border of the hard palate, from the lower surface of the aponeurosis and probably from fibers of the levator palati. Certain fibers pass downward and outward over the azygos uvulae or lie beneath the glandular layer. The muscle itself passes down near the edge of the soft palate and then, in the posterior pillar, into the side of the pharynx, and part is inserted in the upper border of the thyroid cartilage. It also expands into a thin layer just beneath the mucous membrane of the back of the pharynx, which meets its fellow in the midline, where it is inserted in the pharyngeal aponeurosis. Its action is to draw the pharynx and thyroid cartilage upward and at the same time approximate the two posterior pillars of the fauces. It also acts to depress the soft palate.

PALATOGLOSSUS

The palatoglossus is a small bundle arising near the midline on the oral side of the lower part of the soft palate. This forms, by its projection, the anterior pillar of the fossae, by which it runs to the tongue, where it joins the transverse fibers. The pair of muscles act as a sphincter tending to close the passage from the mouth to the pharynx. They, also, act to raise the back part of the tongue and to depress the soft palate. A thin expansion from this muscle passes over the tonsils. The levator palati (the elevator of the soft palate) arises from the under surface of the apex of the petrous portion of the temporal bone and from the cartilaginous portion of the eustachian tube. It descends obliquely downward and forward, and, broadening out, enters the substance of the soft palate and is inserted into the aponeurosis. Its

action is to elevate the soft palate. We believe that it is the action of the levator palati that helps to pull the flaps apart, which results in so many of the postoperative openings that we see. In the surgical procedure for cleft palate, greater attention should be given to this muscle than has been done in the past. If splints are used, they should be placed in such a position as to include this important structure.

In the whole surgical procedure from the first operation until the final one, the surgeon should have in mind placing all of the structures which go to make up the hard and soft palate in their normal position. The normal soft palate is flexible, and, consequently, an essential in an operation on the soft palate is that the muscles not only be placed in their normal position, but that this be done with formation of a minimum amount of cicatricial tissue.

Sometimes, reconstruction meets with considerable difficulty, owing apparently, to a shortening of the palatal tissues with a resultant tension where the palate is reconstructed to its normal length. Brophy recognized this condition early and attempted to overcome it by forcing the posterior portion of the palate together slightly at the time of closure of the anterior alveolar portion. Let us revere the name of Brophy, who, by his untiring efforts, led us so far in this work; but let us be broad enough to accept advancement of his theories if it can be shown that they can be improved on. Many eminent and experienced men are maintaining that better results may be obtained without the use of the plates and wires which Brophy advocated for reducing the complete cleft in infancy. Their contention is that the superior maxillae is hardly ever normal after the Brophy operation; that the teeth are either malformed or displaced, the superior maxillae being underdeveloped and a seeming prognathism of the inferior maxillae existing.

At the present time, two researches are in progress which may throw some light on this phase of the operative procedure. William H. G. Logan is attempting to determine the exact position of the tooth buds in infantile jaws under 3 months of age.

At the University of Michigan, we are making actual measurements of infantile jaws to ascertain how much wider, if any, the cleft palate maxillae is than normal. We are, also, operating on infants by two methods, one the Brophy method by plate and wires, the other bringing the normal tissues together, using the normal lip and cheek pressure to reduce the cleft. We are keeping a record of the measurements of these clefts before operation under both methods and will again measure the jaw before the final operation. In time, the results over a large series of cases should give us some valuable information.

If, as is claimed by many, the malar processes do not act as a fulcrum to widen the space between the tuberosities when the anterior alveolar portion is closed, then why use lead plates? There has not been sufficient proof on either side at this time. Another question that can be asked is, Why use a wire to close the anterior alveolar cleft? Will the normal lip pressure after the closure of a cleft lip be sufficient to do it? Much study and research covering a large series of cases will only satisfactorily answer these questions. If the same results can be obtained without the use of plates and wire, surely great advancement will be made.

In the meantime, until we know more about some of these perplexing questions relating to the operative procedure, let us

all endeavor to reduce these clefts of the palate and lip with the least amount of trauma, so that we will obtain the minimum cicatrix. Then, in the soft palate, let us endeavor to place the musculature of the palate in its normal position. We should remember that in all of these cases, regardless of how successfully these tissues have been placed, speech training is just as important as the operation, if the children are to be restored to society.

Intelligent instruction in the art of speaking correctly should always follow the operation. Training will do more for improvement of speech than will the operation. In these cases, speech is always defective in three important particulars; namely, resonance, melody and articulation. Resonance and melody of the voice cannot successfuly be restored by the operation alone on account of the limited control that results from the palate's being more tense than normal, owing to the operation. The tenseness of the palate will prevent the regulation of the size of the opening between the oral and nasal pharynx, which is constantly changing in the process of phonation. The nasal resonance will depend largely on the ability of the patient to close this opening. The melody of the voice depends largely on the functions of the pharyngeal muscles, and unless these muscles are placed in their normal position, normal melody of the voice will be difficult to obtain.

The teaching of cleft palate patients to speak perfectly should be begun soon after the closure of the palate, and it will require constant effort on the part of both teacher and pupil to perfect phonation. Albert Salisbury, in his work on phonology and orthoepy, makes this statement: "Correct enunciation and resonance depend primarily upon the correct position of the several organs of speech. It is, therefore, of vital importance that the teacher should in the first place know what the correct sounds are to the ear, and in the second place, what the correct positions of the oral organs are for producing the exact sounds required." The closing of the palate is essential to keep the current of air moving in the natural way. After the operation is completed, the muscles must be trained to act as they do in the normal mouth. The training of the musculature is just as essential to correct speech as is the closing of the palate. The teacher should have in mind a clear picture of the speech mechanism, which includes the palate, lips and the teeth, and should teach the patient how to place the tongue in the mouth in order to produce normal articulate sounds. The patient should be kept in training under immediate supervision until there is every reason to believe that the patient himself will follow up the instruction. This requires in many cases many months of persistent effort on the part of the patient.

Edna Hill Young, in a comprehensive treatise on "Overcoming Cleft Palate Speech," makes this statement: "In considering the help needed by the child born with cleft palate, it is necessary to bear in mind two things: one is the physical mechanism which comes with birth, making speech possible; the other is the habit forming process gained by speech after birth." This process works the physical mechanism correctly or incorrectly, according to the nature of the musculature habits acquired. The physical mechanism must be normal: otherwise, speech is very apt to be proportionately imperfect. The musculature habits formed must follow an exact, definite pattern in order to have speech correct. Musculature habits carry with them a strong tendency to keep on as it is begun. Consequently, if normal phonation is to be expected, the palate

should be closed before the habits of speech are established, so that the musculature habits will take on a normal order.

Today, most cities have a corps of teachers for defective speech, and they are doing much in the training of these unfortunate children. The surgeon who operates with success in these cases should recognize that his work is only half done. He should insist on speech training in every case, and he will thus do much to improve the mental attitude of these children and to increase their happiness.

DISCUSSION

W. H. G. Logan, Chicago, Ill.: The paper Dr. Lyons has just presented contains ideas that in the immediate future should be forthcoming from other leaders in the field of cleft lip and palate surgery. I share with a few others the belief that the different groups of leaders, instead of continuing their efforts to make converts of each other, should submit additional evidence to substantiate their claims that the technic which they follow will produce the best end results. It is interesting to recall that it was nearly a century and a half ago, or, to be exact, in the year 1764, that LaMonier performed his first operation for the surgical closure of cleft palate, and, since that time, there have appeared a vast number of treatises and monographs, as well as numerous textbooks, dealing with all phases of cleft lip and palate deformities and their surgical closure. Therefore, at this time, one might very appropriately consider just what important features of this problem have not been fully investigated by the outstanding oral and plastic surgeons of this and former days, and what have been, and what are, the points of greatest controversy with regard to the entire question of cleft lip and palate surgery.

Before expressing an opinion on the research problems needing investigation, permit me to call to your mind that, in the early days, controversial discussion with regard to the cleft palate problem centered around the question as to when surgical correction should be undertaken, i.e., whether in infancy or in early adult life. Until about 1880, the majority were in favor of performing the operation in early adult life, but since about 1890, when Truman W. Brophy first presented his technic for the correction of complete cleft of the soft and hard palate and alveolar ridge, and Sir Arbuthnot Lane (1902) appealed for the early operation, there have been an increasing number who advocate operating in all cases of congenital deformity of palate or lip in early infancy without regard to the extent of the deformity. There has been a very decided disagreement as to the best technic to follow.

The present major difference of opinion is based upon the acceptance or rejection of the application of a single principle: Is one justified, in the early weeks of life, in making use of the direct application of force, by means of silver wires and lead plates (Brophy), in order to bring the separated borders together in the line of the alveolar cleft and hold them there until union takes place, and at the same time reduce the width of the cleft straight in from the tuberosities to a point that the advocates of this procedure contend is normal; or is one justified only in resorting to the indirect application of force to bring the separated borders together in the line of the alveolar cleft by relying on the action of the muscles which are brought into function by surgical repair of the cleft lip, giving no consideration to the reduction of the width of the cleft through the bone straight in from the tuberosities?

The indirect application of force does not call for the placing of the maxillary alveolar ridge through the line of the cleft, as well as the median line, in its normal relation with the mandibular ridge; nor does it provide for a union between the separated borders of the cleft through the alveolar ridge. Likewise, it does not take into consideration a reduction in the width of the cleft at the posterior border of the hard palate.

From these brief statements, you will readily understand the need of learning what is the normal, as well as the usual, condition presenting for correction when a child is born with complete cleft through the soft palate, hard palate and alveolar ridge.

Although I have seen photographs of models and specimens of fully developed fetuses which revealed the relationship existing between the maxillary and mandibular ridges through the line of the deciduous molar teeth and the location of the deciduous teeth in frozen specimens, I have never seen a series

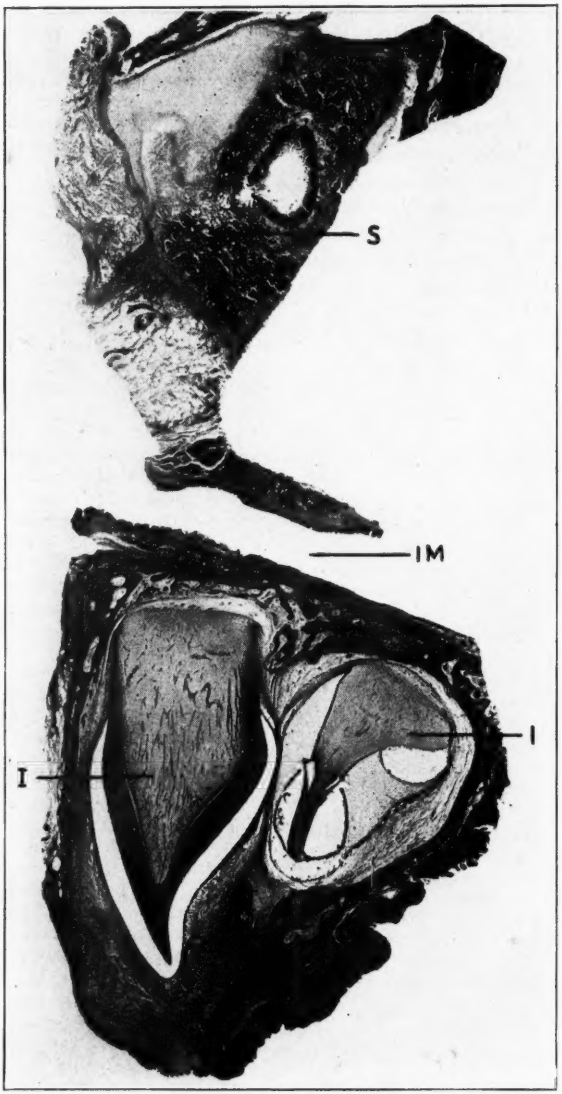

Fig. 1.—Labiolingual section through the upper central incisor region, in a child, aged 6 months. *I*, deciduous central incisor (the empty space around the dentin was formerly occupied by the enamel). *1*, permanent central incisor, with beginning formation of enamel and dentin at the tip of the cusp. *IM*, inferior meatus. *S*, section through the septum of the nose, showing cartilage and bone. (× 6.) (Sections [Figs. 1-6] from the Research Department [Director, Rudolf Kronfeld] of the Chicago College of Dental Surgery, Dental Department of Loyola University.)

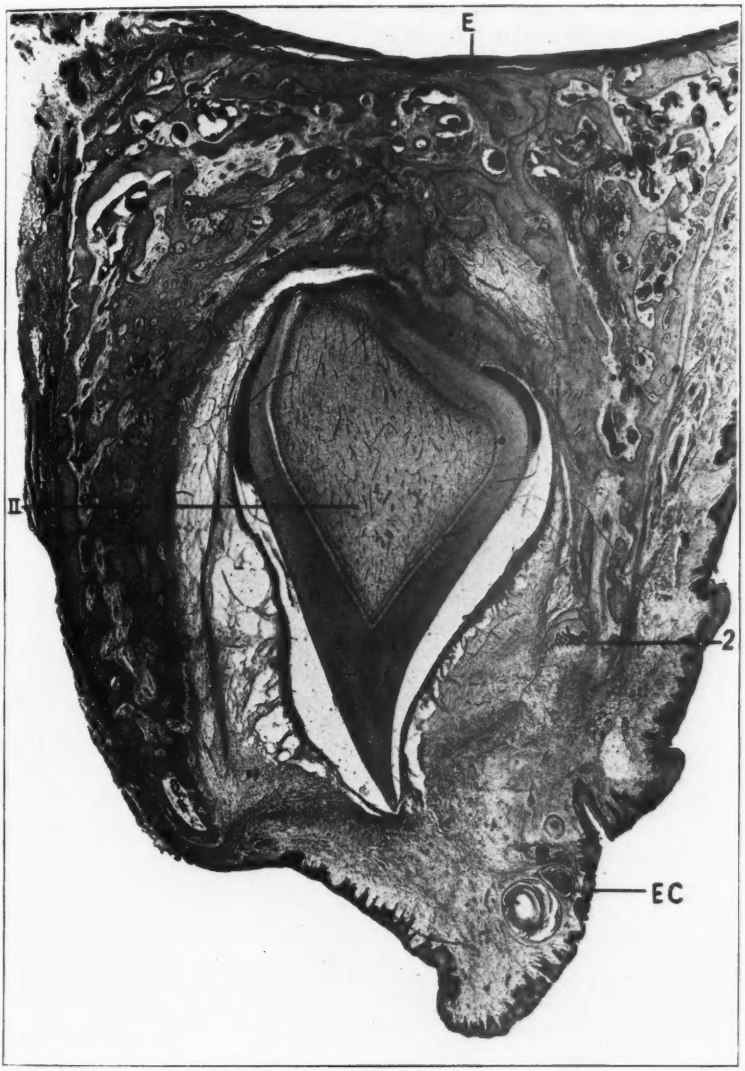

Fig. 2.—Labiolingual section through the lateral incisor region, in a child, aged 6 months. *II*, deciduous lateral incisor. (This section does not go through the center of the tooth germ.) *2*, germ of the permanent lateral incisor, consisting of a solid epithelial bud lying on the lingual side of the deciduous tooth. *E*, epithelium lining the floor of the nasal fossa. *EC*, epithelial coils (remains of the dental lamina). (× 12.)

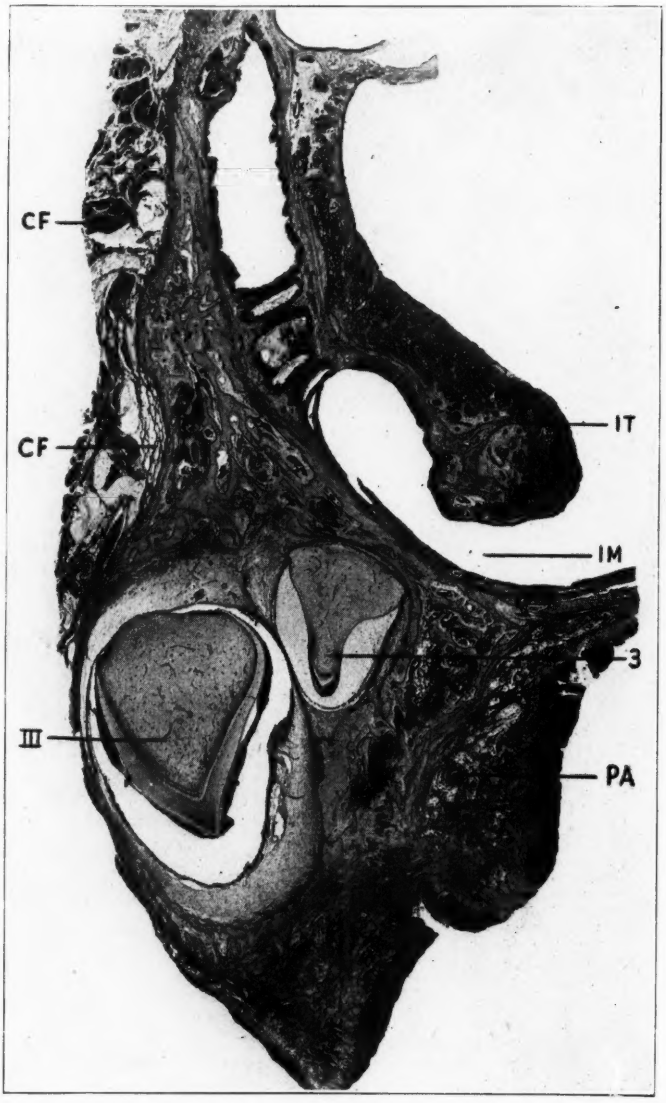

Fig. 3.—Labiolingual section through the upper cuspid region, in a child, aged 6 months. *III*, deciduous cuspid. *3*, germ of the permanent cuspid lying lingually and above the germ of the deciduous cuspid. *PA*, palatine artery. *CF*, muscle and fat in the canine fossa. *IM*, inferior meatus. *IT*, inferior turbinate. (× 6.)

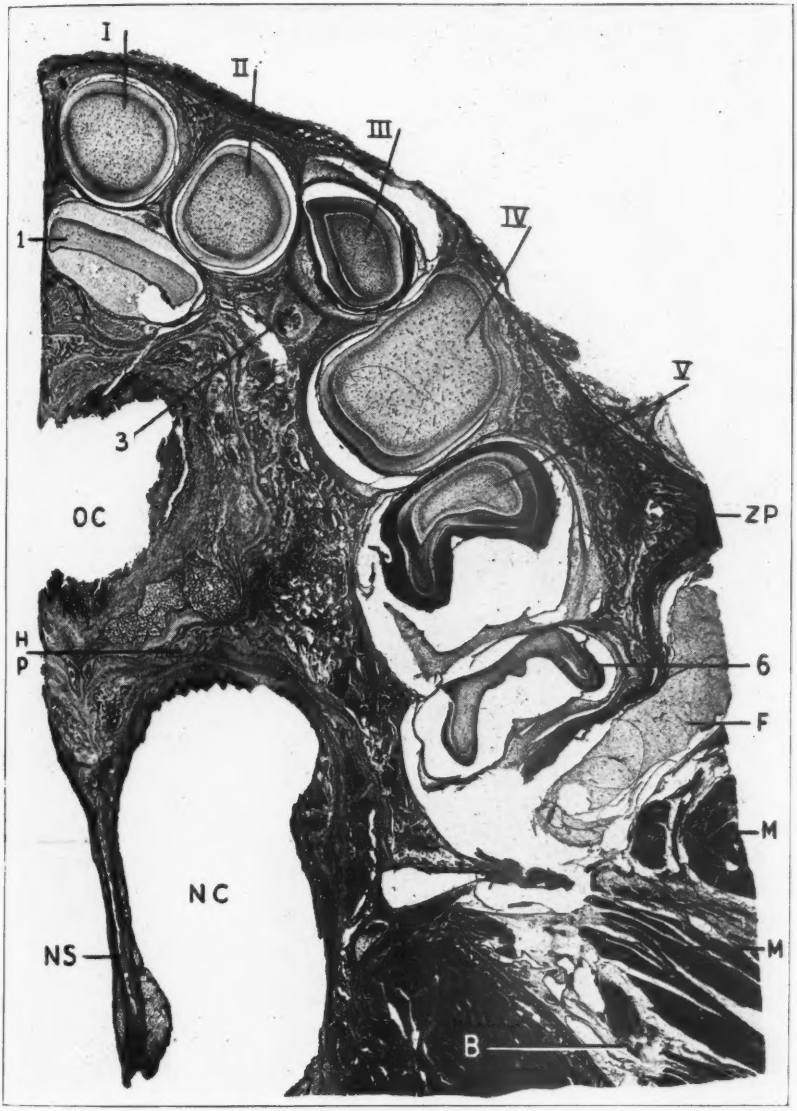

Fig. 4.—Horizontal section through the right maxilla, in a child, aged 6 months. *I*, decidous central incisor. *II*, deciduous lateral incisor. *1*, germ of the permanent central incisor lying lingually from the deciduous central and lateral incisors. The germ of the permanent lateral incisor cannot be seen in this section of the series. *III*, deciduous cuspid. *3*, tip of the germ of the permanent cuspid. (Compare with Fig. 3). *IV*, first deciduous molar. *V*, second deciduous molar. *6*, first permanent molar. *OC*, oral cavity (section through the curvature of the palate). *NC*, nasal cavity. *HP*, hard palate. *NS*, nasal septum. *ZP*, zygomatic process (malar process). *F*, fat behind the tuberosity of the maxilla. *M*, pterygoid muscle. *B*, base of the skull. (× 4.5.)

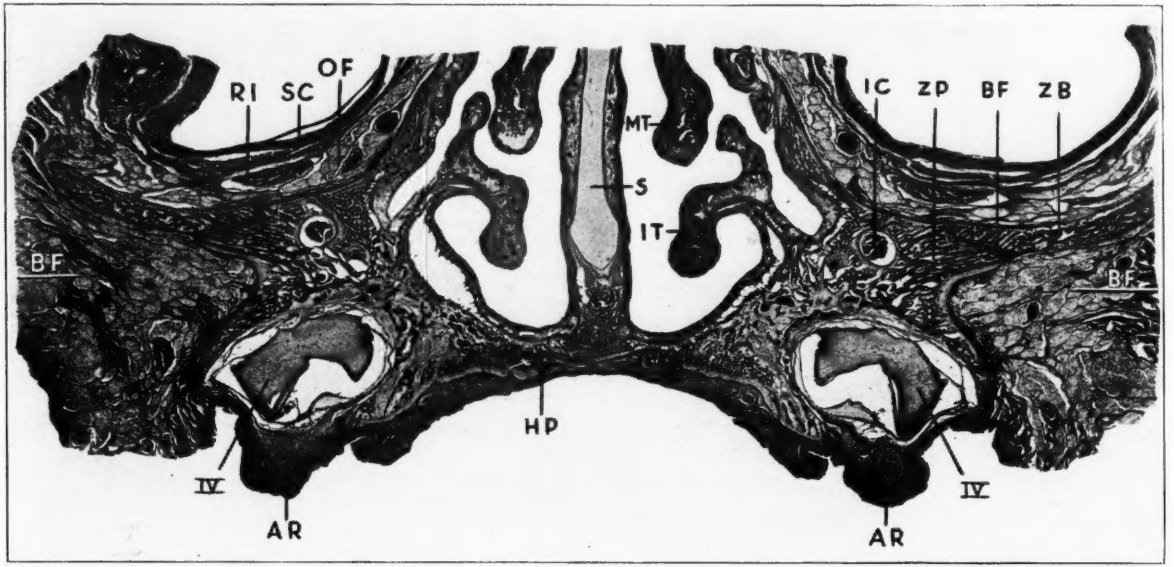

Fig. 5.—Transverse section through entire upper jaw, nasal cavity and orbit, in a child, aged 2 weeks. *AR*, alveolar ridge. *IV*, deciduous first molar. *HP*, hard palate. *BF*, buccal fat. *ZP* zygomatic process (malar process). *ZB*, zygomatic bone. *BF*, bony floor of the orbit. *IC*, infraorbital canal. *OF*, orbital fat. *RI*, rectus inferior muscle. *SC*, sclera of the eye. *S*, septum of the nose. *IT*, inferior turbinate. *MT*, middle turbinate. (×4.)

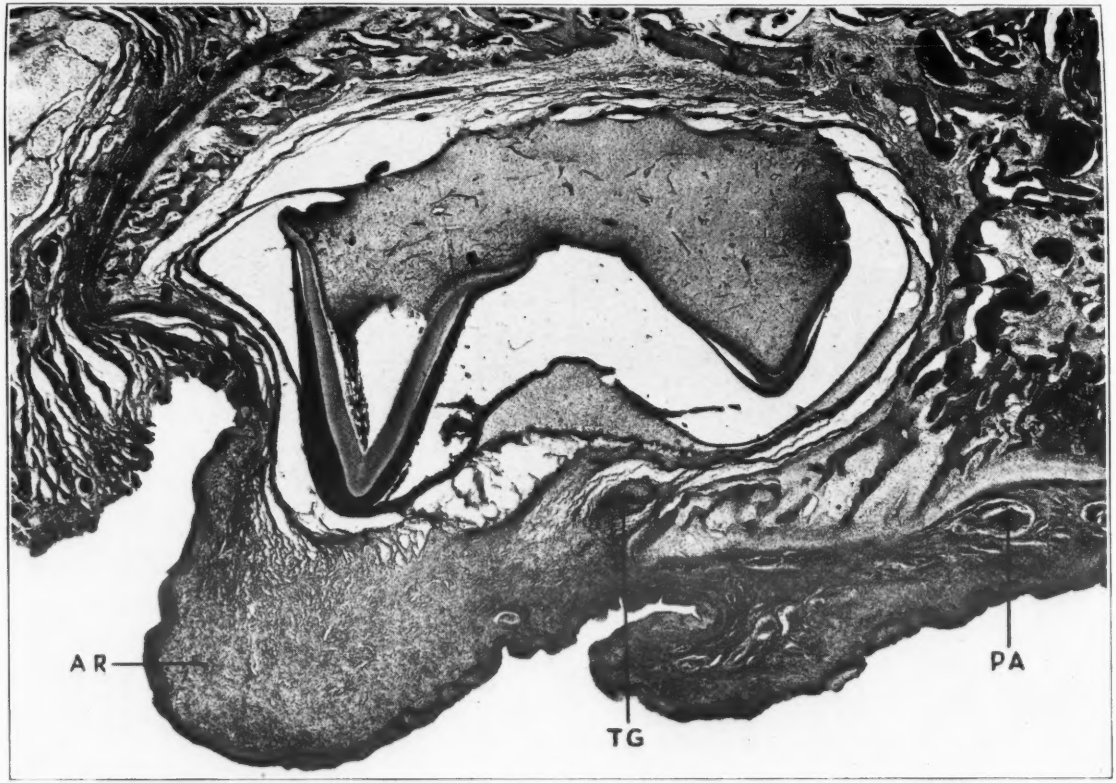

Fig. 6.—Higher magnification of one of the first deciduous molars in Figure 5. The cusps of this tooth show the beginning formation of enamel and dentin. *AR*, alveolar ridge, composed of fibrous tissue. *PA*, palatine artery. *TG*, germ of the first bicuspid, consisting of a small solid epithelial bud. In all the specimens examined between birth and 6 months of age, the germs of the bicuspids were found located in a position occlusal to the deciduous molars. (×20.)

of models or specimens which revealed the normal relationship of the tuberosities to the mandibular ridge, or the maxillary ridge to the mandibular ridge in the median line and through the alveolar ridge at the point where the cleft usually divides the upper jaw. Yet this last is of equal importance to the location of the tuberosities under normal and abnormal conditions. Likewise, to my knowledge, there has never been presented a series of models or specimens showing the relationship of the alveolar ridges in congenital deformity that only partially involved the palate. Such a series is of utmost importance in determining whether, in the majority of cases in which the upper jaw is either partially or completely divided with a cleft, there is not a rather constant deviation from the normal in the relationship of the maxillary to the mandibular alveolar ridge.

I believe that I am stating an accepted truth when I affirm that all workers in this field will welcome such information and will await with interest the forthcoming report from the University of Michigan, College of Dentistry, that is to be made by Dr. Lyons, as well as my report on the findings from the Research Department of the Chicago College of Dental Surgery, Dental Department of Loyola University, dealing particularly with the location not only of the deciduous germs, but—what seems to me of more importance—the position of the germs of the permanent teeth between birth and 6 months of age; also the normal relation of the maxillary and mandibular alveolar ridges at this age.

A vital question bearing on the importance of accepting or rejecting the methods now in vogue for the direct application of force to establish either bony or soft tissue union of the cleft through the alveolar ridge and reduce the width of the cleft posteriorly depends on the ability of the operator to make use of the direct application of force in such a manner as not to cause destruction or irregularity of the germs of the permanent teeth; also to avoid carrying the maxillary ridge inside the mandibular ridge between the cuspids, with a resultant flattened appearance of the upper jaw and the teeth erupting to the lingual aspect of the lower incisors.

Many advocates of the direct application of force believe that if the wires are placed high, marked irregularity of permanent teeth can always be avoided. Yet, as far as I know, no one has ever investigated and presented evidence as to the location of the germs of permanent teeth at the age that one must operate for the bone correction. You will all agree that, with the exception of knowledge gained from practical experience, the presentation of evidence regarding the location of the germs of permanent teeth should be the basis for any claim that one can pass wire sutures at any point through these structures and not cause serious injury to these teeth. And I may say that, with this study well in progress, it is readily understood why some patients in adult life have little or no irregularity of teeth as the result of the direct application of force (silver wires and lead plates), while others have not been equally fortunate. Evidence also seems to have been found as to why there is sometimes a flattening of the bone immediately beneath the nose for a part of the distance between the cuspids in the maxilla, while, in other instances, the maxillary ridge and anterior teeth are normal. We have been without fundamental knowledge as to the cause of this in the past. Therefore, in given cases, we have never known quite positively what were the major contributing factors to the ideal or the unfavorable end results.

I believe that you will agree with Dr. Lyons and me that there is need of research work in this field, and it is our hope that we may contribute something toward this very obvious demand. Although Dr. Lyons and I have been and are making use of the direct application of force (Brophy method) and securing what our colleagues in this field say are, by comparison, most satisfactory end results, neither of us is content to believe that our technic may not be improved on when we have at our disposal additional fundamental knowledge. We are only interested in finding the best way to correct the congenital deformity of cleft lip and palate so that persons so afflicted may take their places in society without discomfort and embarrassment. I think that we are also agreed in the principle that the construction of a normal-appearing lip and external facial expression is but a single item: this must be accompanied by satisfactory speech; otherwise, failure in part will be the result, where success might have crowned our efforts if we had been more conscientious students of the entire problem. So I desire, at this time,

to throw on the screen what is, as far as I know, the first evidence that has been presented showing the exact location of the germs of the permanent teeth between birth and 6 months, with the hope that these slides will serve some useful purpose to those interested in the cleft palate problem. (Only six of the total number of slides shown are here reproduced.)

Dr. Lyons, Ann Arbor, Mich.: Dr. Logan has presented a distinct contribution to the profession. I have never seen slides or sections of the jaw at this early age made as Dr. Logan has made these, and some of them come almost as a shock, for they change all of my preconceived ideas relative to the early development of the teeth and jaws. Certainly when Dr. Logan gets this research completed, it will throw a great light on what we are attempting to do in operating in these cases. Unfortunately for dentistry, nearly all the anatomy of the head that we know has been worked out from a standpoint of general surgery or general medicine, much of detail having been overlooked. I had not the slightest idea that we would ever find a permanent tooth bud at the side of the deciduous tooth. It is going to mean much to us who are doing this class of work if the permanent tooth buds are proved to be situated at the side of the deciduous tooth. One of the great objections to going through the jaws with wires in cleft palate work is the fact that the permanent tooth buds may be disturbed. When Dr. Logan gets this work completed, we shall know definitely just where these tooth buds are, and some means will be devised, perhaps the same principle that we are working on now or some other, to establish a normal maxillae, and that is what we are working for. One child in 1,200 is born with cleft palate and cleft lip, and if we can restore that child to a normal condition so he may eventually take his place in society, the work has really been worth while.

THE STATUS OF DENTISTRY IN OUR ECONOMIC SYSTEM*

By MICHAEL M. DAVIS, Ph.D., Chicago, Ill.

DENTISTRY is not a business, but a profession, and it is not without profound recognition of its high professional aims that I venture to present some business or economic considerations which influence both its financial and its professional future.

What is the relation between the demand of the public for dentistry and the supply of dental service? What is the relation between the cost of dental service and the public demand for it? What is the relation between the cost of dental service and its technic and organization?

The demand for a service must not be confused with the need for it. The need for dental service is universal. The demand for it is far less than the need. Some persons live in towns or villages where dentists are few or are inaccessible. Some persons who live within a stone's throw of a dentist do not think they need to go to him unless they have a toothache which is not relieved by something bought from a drugstore or a bootlegger. Many other persons buy far less dental service than they would like because they think it costs more than they can afford.

*From the Julius Rosenwald Fund.

*Read before the Section on Dental Economics at the Midwinter Clinic of the Chicago Dental Society, Jan. 13, 1930.

The demand for an ordinary commodity is increased by promoting the recognition of need for it. In business, this is generally done by advertising. In dentistry, it is done by publicity measures which we call education. The demand for a service is generally increased by lowering its cost, since more people will then buy it or the same people will buy more of it. A larger volume of service rendered, even at a lower payment per unit of service may mean a larger return, both gross and net, for those rendering the service. Henry Ford's millions were the result of application of this principle.

These statements are all truisms; but I have one more definition which may be less obvious. Demand is of two kinds: latent or effective. The effective demand for automobiles in the United States is expressed by the 26,000,000 which have actually been purchased. The latent demand for automobiles is represented by the desire of some millions of additional people who want them but who "haven't the price." When a sense of need is aroused through education, a latent demand is created for the commodity or service meeting that need. When the commodity or service is available at a price which these potential consumers will pay, a latent demand is transformed into an effective demand, and need is satisfied.

During the last twenty years, the number of dentists in the United States has increased more rapidly than the population, but not very much more rapidly. An immense increase has taken place in the public recognition of the importance of dental service. Higher professional standards, the newly recognized interrelation between dentistry and general health and, above all, large educational and advertising programs have created a demand for dental service such as never existed before. A good deal of this is effective demand which expresses itself in seeking dental care and paying for it. Unfortunately, a great deal of the demand remains latent and ineffective.

Dental practitioners are licensed by the state to render service to the people, and are entitled to a remuneration for their work on a scale adequate for professionally trained men who are trying to rear their families in twentieth-century America. The primary obligation of the profession is public service, and the profession cannot but view with concern—indeed with alarm—a situation in which an increasing number of our citizens are taught to recognize a dental need which they feel they cannot meet. We have proceeded with programs of education which have transformed needs into latent demands without a due proportion of effort to make facilities available whereby those demands can be made effective in action.

What should be done? What can be done?

In the United States, there is approximately one dentist to every 1,800 of the population. A single dentist, working as a private practitioner, cannot, on the average, render adequate service to much more than 30 per cent of this number. Hence, taking the country as a whole, there is a shortage of dental facilities. The real situation is less simple than the general average suggests, because the cities, comprising about half our population, have dentists in the ratio of about one to every one thousand population or less. I cannot discuss today the grave deficiencies in most towns and rural areas. In the cities, the potential dental service available is enough to make it worth while

endeavoring to bring actual service closer to actual need. Practically, this means effort to transform latent demand, now existing among millions of city dwellers, into an effective demand which will seat them in dental chairs.

In a paper published a little over a year ago,[1] I cited expenditures for dental service of 1,226 working class families studied in Boston, New York and Philadelphia, from whom facts were collected in 1918-1919 from the U. S. Bureau of Labor Statistics. Sixty-one per cent of these families spent nothing for dental service in the course of a year. Three-quarters of the families with an income of $1,200 a year or less spent nothing for dental care; while of the families with incomes of $2,500 and over, only one-quarter secured no dental service. Only 2 per cent of the families with incomes of $1,200 spent over $30 a year; while 20 per cent of the families with over $2,100 annual income spent over $30.

We shall not have authoritative and up-to-date figures until the Committee on the Cost of Medical Care and the American Dental Association have carried through cooperative studies which they are now getting under way. We do know that there are great differences in the amounts spent for dental service among different groups of the population and that these divergencies are partly due to differences in incomes. Variations also exist because of the individual's recognition of the value of dental service, his dental standard of living, we might call it. A recent study of school teachers' budgets in New York State indicated an allowance of approximately $10 a year for dental service for women teachers with an income of $1,200. If this rate of expenditure actually existed throughout the whole population of Chicago, the average income of dentists in this city would exceed $10,000 per year. I leave this audience to draw the deduction.

Teachers presumably have a better understanding of the value of dental service and will spend more money for it out of a small income than many other people. We have good evidence of this from the study of Prof. J. B. Peixotto, of the University of California, which was quoted in my previous paper. Here were ninety-six families of the faculty of the University of California, of which 60 per cent were living on less than $5,000 per year, the average being $4,000. Only six families reported no expenditures for dental service throughout the year, and the average expenditures per family of the whole group was $50. Here, again, the amount expended varied considerably with the income. Yet even with the professors and instructors receiving the lower incomes, more than one-third of the families spent $50 a year or more; and when the total annual income was $6,000 or more, more than half the families spent over $100 on dental service in a year. Professor Peixotto comes to the conclusion that these educated families have a full understanding of the desirability of adequate dental service and that their demand for it is limited only by its cost.

I am quite ready to admit that so-called lack of ability to pay for dental service may, in some cases, be lack of readiness. The desire for automobiles and radios and various lesser luxuries competes with the need for dental service for a place in the family budget. The business man has learned that nothing

1. Davis, M. M.: Dental Care and the Family Budget, J.A.D.A., 15:2039 (Nov.) 1928.

is gained by scolding potential customers because they buy from his competitors. Business men and the dental profession face a condition and not a theory. They must deal with the situation in terms of psychology and not in terms of blame.

The great economic problem ahead of the dental profession is the transformation of latent demand for dental service into effective demand. This transformation can be assisted by educational measures, but will not proceed far as long as the cost of service seems high in comparison with other expenditures which large groups of the population feel to be necessary charges on their limited incomes.

Larger incomes for the population would be a theoretical remedy. Estimates of national income and its distribution among the population which have been made from time to time of recent years, especially by the National Bureau of Economic Research, indicate that, in 1918, 86 per cent of the population had annual incomes of less than $2,000, 94 per cent less than $3,000 and 98 per cent less than $5,000. Only two-thirds of 1 per cent had an income of over $10,000. The total national income has increased appreciably since the war in proportion to population, and a little larger proportion of the people are enjoying higher levels of income; but we cannot expect that any great and striking change in the total income of the nation or its distribution among the social classes will soon take place.

It is still true that the great majority of self-supporting American families are living on incomes near $2,000 a year. About 1925, the State Housing Commission of New York estimated that two-thirds of the families in New York City had incomes of less than $2,500. For the vast majority of families, the margin of income over necessities such as food, rent and clothing is so slight as to make the pull of competing demands on those precious disposable dollars very severe and very conflicting.

May I quote from the paper previously mentioned?

> The rates charged by dentists appear moderate or high to the patient in proportion to his means and according to his point of view. The patient does not readily appreciate that the dentist must depend for his living on his working time and that, according to what seems to be a usual estimate, about one-third of his income must go toward meeting his professional expenses, leaving only two-thirds of his gross earnings for himself and his family. The dentist who charges $3 for an amalgam filling, taking him half an hour, is charging at a rate (working 1,600 chair hours) that would yield him a net income of only $6,400.
>
> It is always difficult for one person to understand sympathetically the other fellow's budget. A woman writes complaining bitterly of a dental bill for "One gold crown, $20.00; one gold inlay, $17.50; and four tiny fillings of alloys, $10.00. The bank check of $47.50 which I gave his (the dentist's) nurse was a *whole week's pay* for my husband." The patient's view necessarily depends on the relation between his expenditure and his income. Whether the layman who sits in the chair knows less about the dentist's finances than the dentist knows about his patient's may be a question. Certainly, the facts in this paper seem to indicate that the greatest limitation on the average dentist's earning power is the limited amount that can or will be spent by most families for dental care in competition with the innumerable other demands on the family budget.

We should by all means keep on with programs of dental health education, and such programs must emphasize preventive dentistry as well as reparative. It must be recognized that, to a large extent public understanding and use of any preventive service usually follows and rarely precedes the recognition and use

of curative or reparative service in the same field.

The chief measure for transforming latent demand into effective demand for dental service is the lowering of dental costs. I believe this can be done through dental clinics, which would lessen overhead as compared with individual dental offices and which would organize the mechanical and nonprofessional elements in dental service on a larger scale and a more economical basis than is possible for the private practitioner. I believe that an attempt should be made to work out carefully considered experiments to determine how far it is possible, through dental pay clinics, to furnish service at rates which will be paid by large numbers of people who cannot or will not pay the usual existing rates for good dental service. These experiments must carry with them adequate remuneration and sound professional standards for the dentists who participate, and must not lower standards of service or remuneration for the profession as a whole.

Such clinics must furnish dental attention to sections of the population at the cost of service. They must be set up as service agencies, not as business corporations for profit. On the other hand, they must not present themselves to the public as charities, because the mass of the American people do not want and will not accept charity. They must be organized as joint enterprises of the public and the profession. It is neither practicable nor fair to ask the profession to finance the initial capital investment or take the financial risks of the experimental periods. Lay and dental groups must cooperate in their initiation. The professional aspects should be planned and controlled by the dental profession.

I am not prepared to predict just how much dental pay clinics will reduce cost, nor how large a proportion of the population they can or should serve. I have had opportunity to observe numerous dental clinics and, in some cases, to study their costs. These observations lead me to believe that pay dental clinics are worth experimenting with as a means of reducing costs and of transforming latent demand for dental service into effective demand. I do not see how anyone can tell, without actual experimentation on a sufficiently large scale, just how much and how far this means of dealing with the needs of the community for dental service will take us. I am far from proposing pay dental clinics as a panacea. I am not proposing them as a national program. I am proposing them as experiments. They will necessarily be local in their individual scope, but they should be national in the sense that they ought to be under the eyes of national groups, so that their significance for the whole people as elements in a broad dental service program can ultimately be appraised.

Such experiments should hold much of value for dentists as well as for the public. Pay clinics—in which patients pay and dentists are paid—will afford remunerative openings for well-trained dentists who either like to work in an organization or who have slack time in their private offices which they would gladly turn to account in a pay clinic. Properly conducted pay clinics will not, in my opinion, compete unfairly with private practice. They will compete with dental parlors and dental quacks. They will bring sections of the public to receive dental service who now go with little or none. They will accomplish these ends somewhat in proportion as they receive adequate and discriminating publicity.

It seems also important that the dental profession shall itself take the initiative in meeting public needs. The educational programs which are now under way and which are creating demands for dental service may have serious consequences if the demand runs too far beyond the provision of dental facilities at a cost which the people believe they can meet. The people have the power to take the matter in their own hands and to endeavor to provide for themselves through legislation or through commercial organizations.

It seems to me that at least four experimental clinics are desirable, two in large cities, such as Chicago and New York, and at least two in smaller cities. It is essential to have a sufficient number, and it would be well to have pairs in communities of comparable type so that we shall have the necessary comparisons and controls, eliminating merely local differences in financial and professional results. The Julius Rosenwald Fund is ready to cooperate financially in such experiments. They should be self-supporting ultimately, but will need some initial working capital, and perhaps an underwriting fund to cover possible deficits during an experimental period. We should welcome, for instance, the opportunity to work with a committee of the Chicago Dental Society or of the American Dental Association in planning and helping to finance such dental pay clinics during an experimental period.

This proposal makes its approach from the side of reparative dentistry, but, if rightly planned, it will link up with the educational and preventive program for both adults and children. There is *no one* cure for the community dental problem. This problem is complex. The solution ought to be based on research and on prevention. But people meanwhile go to the dentists, dental bills are difficult for many people to pay and reduced cost of dental service, if it can be brought about without lowering professional standards, will be of advantage to the public, and can be used as an educational measure toward better understanding and support of preventive activities.

The proposal presented here is that the dental profession step courageously forward, facing a public need with a plan for meeting it. Its adoption should result in the enlarging of service rendered by dentistry and elevation of the profession both in financial status and in public esteem.

DISCUSSION

Benjamin S. Partridge, Chicago, Ill.: This type of work is not new to the Public Service Committee of the Chicago Dental Society. Our job is to serve this vicinity in dental health matters and to cooperate in all general health matters. Our committee of about thirty men has nine divisions, three of which are now assisting somewhat similar organizations; namely, the division of Children's Dental Clinics, which six years ago helped to establish and is now helping to operate the Cook County Children's Dental Dispensary; the division of Industrial Relations, which assisted in the organizing, and is now assisting in the operation of, the Amalgamated Garment Workers Union, and the division which assisted the commissioner of health of the City of Chicago in establishing the public school dental clinics and is now helping in operating them. All of these dental health projects required careful study and preparation. The Public Service Committee has given leadership to all of the dental clinics mentioned, and is prepared to give leadership to the great project suggested by Dr. Davis. We desire that whatever plans are made shall have the wholehearted support of our entire organization in giving good dental service to the part of the public that is not receiving it at present (the 80 per cent that Dr. Davis mentions in his paper), and to that end we will gladly cooperate with the Rosenwald Fund

in formulating plans for this splendid work that will meet the full approval of the whole dental profession. Therefore, Mr. Chairman, I move that those assembled in this meeting of the Section on Dental Economics recommend to the Chicago Dental Society that steps be taken to cooperate with the Julius Rosenwald Foundation in the proposed establishment of experimental dental pay-clinics in Chicago. [The motion was seconded and carried.]

Harold J. Noyes, Chicago, Ill.: We are all too prone to consider dental economics in the narrow and restricted details with which we come in most intimate contact, and, by so doing, we fail to recognize the more fundamental issues, which have a far more profound effect on our welfare. It appears from figures given in this paper that dentists in private practice are serving little more than 10 per cent of the population of this country. The crowding of the few institutional clinics bears out this observation; and the success of the many commercial "dental parlors" is further testimony that, to use Dr. Davis' terms, we are increasing the latent demand for dental service more rapidly than the majority of incomes will permit it to be transformed into effective demand for the service of the private practitioner. Our educational program undoubtedly converts a minor portion of this latent demand into effective demand; for there are some who will forego other expenditures to procure dental service when they come to realize its importance. But, at the same time, and through the same means, we are creating effective demand for the commercial organizations and the inferior practitioner because the incomes of most families falling in this class will not bear the tariff of the present dental fees. The aftermath of this type of service, together with the realization of a need which cannot be supplied within the limits of the income of this group, offers a problem for serious thought. When the consciousness of the American public awoke to the need for general education, it was not long before it developed a public school system. The character and extent of this system of public education which is maintained for all by the people of this country it would be difficult to equal anywhere in the world. And, similarly, when the importance of good medical and dental care, which is not as yet adequately realized by either the medical or the dental profession, is understood, I am convinced that a mechanism will be developed to provide it. It should be the privilege and the responsibility of these professions to initiate and direct the change. And if the dental profession gains the vision necessary to carry through such a change, it may save itself from the embarrassing economic position in which the teaching profession finds itself at present. These are aspects of dental economics of far more importance than the details of financing, credits and office management; for I doubt that the most attentive study of such matters would show the modern teacher how to make an income calculated on a 1914 basis supply a 1930 demand. The proposal of Dr. Davis, which is in the nature of a pay clinic experiment, is a suggestion for one line of attack on the problem. He is not advocating free dental care nor the donation of service by the dentist, but a method of organizing our present resources in a more effective manner in order that they may reach a class of which only a small proportion have had any care and most of that care of a quality possessing questionable value. Such a plan would not decrease the private practice of good dentists, but rather would limit their practice to families who desire and can afford more personal attention; in this manner, eliminating a part at least of the work which must be done for reduced fees or no fee at all. The private rooms in our hospitals are not empty because there are ward rooms, and our private schools are not unattended because we have public schools. It is my opinion that private practices would be increased by patients who had come to realize the value of good dental service through well directed pay clinics. The most important aspect of a dental clinic of this nature is the possibility of adequate supervision of the service rendered. It offers a method of placing good dental service within the range of a class to whom it has virtually been denied; it offers a practical way of educating the public in the importance of adequate dental service; it offers a means of collecting and correlating data which would be of immense benefit to the science of dentistry, and it offers profitable employment for the skilled practitioner who has not sufficient practice

among patients capable of paying the fees which it is necessary for him to ask in order that he may maintain his family in reasonable comfort.

SEASONAL VARIATIONS IN BUTTER-FAT VITAMINS AND THEIR RELATION TO SEASONAL MORBIDITY, INCLUDING DENTAL CARIES AND DISTURBED CALCIFICATION*

By WESTON A. PRICE, D.D.S., M.S., F.A.C.D., Cleveland, Ohio

LIFE'S most precious jewel is health, the quest for which becomes an almost universal struggle with the increase of age, when a breakdown applying to various organs and tissues of the body, as well as to the body as a whole, occurs. The causes are, in general, the same; namely, degeneration due to one of the following conditions: disturbed nutrition, exhaustion or wear, or injury from bacteria and their products.

While specialists assign themselves to the particular needs and problems of various organs and tissues, they are, in the last analysis, largely dealing with the same problems. Prior to the advent of Pasteur's great contributions, the emphasis was placed on diatheses or constitutional tendencies. With the advent of Pasteur's disclosures, that invading organisms were present in many of the epidemic diseases, the emphasis turned from the host to the invader. Within the last decade, there has been a marked tendency to reinstate constitutional conditions, putting the emphasis on both the host and the invading organism, with an increasing emphasis on the characteristic host which makes its tissues available as soil for microscopic invasion by plant and animal forms.

This new point of view has stressed the importance of the soil on which the organisms may grow, and this quality has been found to be due, in part, to individual peculiarities of the host, some of which are characteristic of the family and, therefore, are hereditary for the family group. Some other factors are definitely acquired and are known to be variable. We may speak of these as acquired susceptibilities, and they will apply to disturbances in many, if not all, organs and tissues of the body. It is as a part of the general study of those factors in an acquired susceptibility to degeneration or bacterial invasion that the researches being reported in this communication have been directed.

In my paper read before this society a year ago at Minneapolis,[1] I presented data indicating that a condition of decalcification obtains in many individuals, particularly elderly people, though not controlled by age, in which there is a

*Read before the Section on Oral Surgery, Exodontia and Anesthesia at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 9, 1929.

1. Price, W. A.: New Fundamentals For the Treatment and Prevention of Dental Disease Based on Calcium Utilization and Disturbance, with Special Consideration of Factors Determining When an Infected Tooth Becomes a Liability, J. A. D. A., 16:456 (March) 1929.

tendency to rob the system in order to get the chemicals required for the maintenance of function for the needs of life. I also presented data indicating that certain activators are necessary in order that our bodies may utilize various chemicals which are in foods and which the body needs.

These activators have a rôle which, in some regards, might be compared to that of an ignition system of a gas engine in relation to the utilization of the fuel. The problem has, accordingly, enlarged to include three fundamental factors; namely, inherent characteristics of the individual, contributing overloads and the availability of activators in order that efficient health may be maintained in conjunction with an adequate source of energy food factors.

The purpose of this communication is to present data indicating a seasonal variation in certain of the activators which are related to various food products, particularly calcium and phosphorus, the chief constituents of the bones and teeth, but also required in practically all of the tissues, and also to indicate that these seasonal variations seem to have a distinct relationship to the seasonal variations in health and disease.

SEASONAL TIDES IN MORBIDITY AND MORTALITY

It is strange how prone we are to take that which occurs with regularity as essential. Probably almost everyone knows and expects that there will be more sickness and deaths in the north temperate zones in the winter and spring than in the summer and autumn, and most people assume that it is an essential condition of winter. Doubtless, few have suspected that this cycle has its counterpart in a large number of physical expressions other than disease or degeneration. The death rate of the entire United States varies from about 128 in March per hundred thousand to about eighty-five in September, and, in Cleveland, varies from about 110 in March to about seventy in September. These figures for the United States are for the years from 1920 to 1925 inclusive, and for Cleveland from 1925 to 1928 inclusive. In general, these curves are similar except that, for the entire United States for the six years covered, the peak is in February, a month earlier than in Cleveland. This is shown graphically in Figure 1.

Another source of data is the demand for hospital beds in different months of the year, there being a much greater demand in the late winter and spring than in the summer and autumn. This also is shown graphically in Figure 1. The data for this curve, obtained from the Cleveland Welfare Association, are consolidated from sixteen hospitals of this city for the total days of treatment for medical cases, by months. It will be noted from this, as in the two mortality curves, that the peak of demand is in March for 1928, and that there is marked summer and fall depression and then a rapid rise in December.

Many degenerative processes apparently have a cycle of severity or incidence. This is particularly true of skeletal decalcification, one expression of which is familiar to the dental group; namely, the activity of pyorrhea in the destruction of alveolar bone and the development of dental caries. A survey of my clinical records indicates approximately four times as much dental caries in the winter and spring as in the summer and fall.

Particularly conspicuous among the evidences of decrease of immunity will be found the increased susceptibility to respiratory infections which occur in the

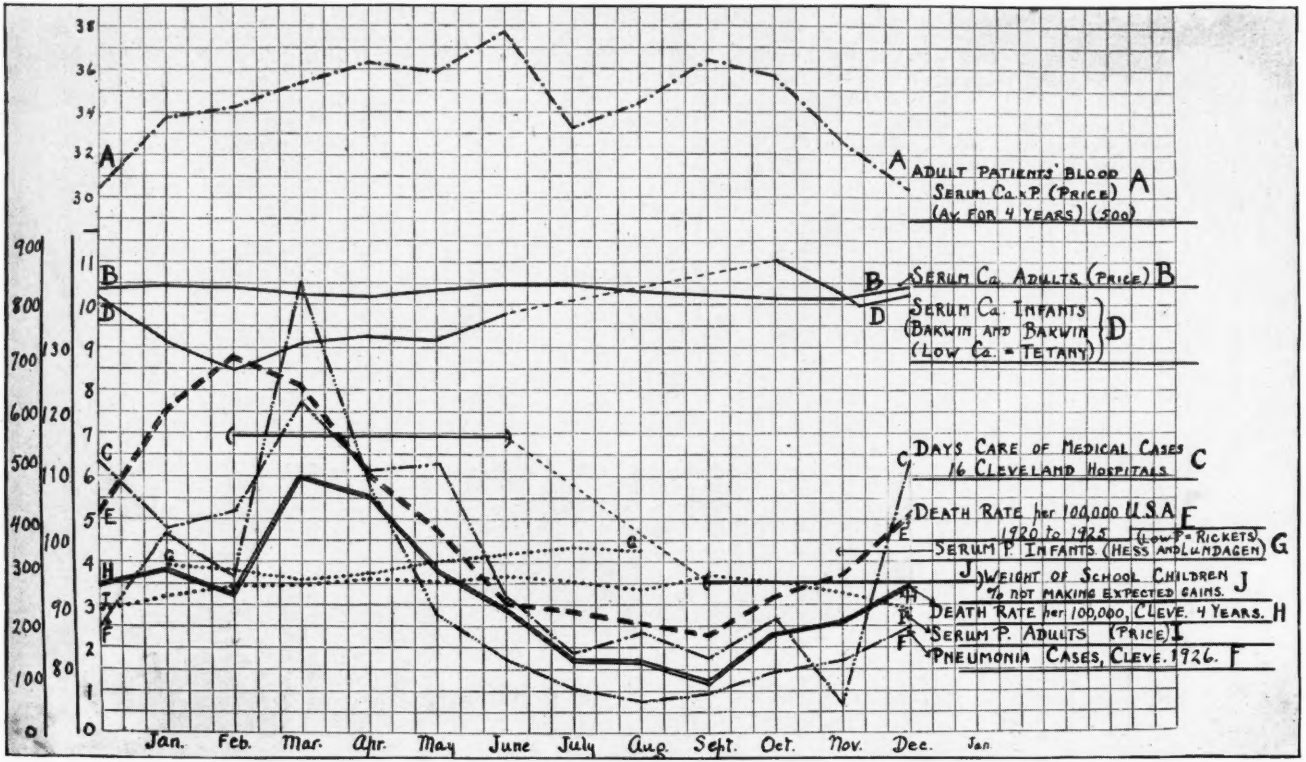
ADULT PATIENTS' BLOOD SERUM Ca & P. (PRICE) (AV. FOR 4 YEARS) (500) A
SERUM Ca. ADULTS (PRICE) B
SERUM Ca. INFANTS (BARKWIN AND BARKWIN (LOW Ca. = TETANY)) D
DAYS CARE OF MEDICAL CASES 16 CLEVELAND HOSPITALS C
DEATH RATE per 100,000 U.S.A. 1920 to 1925 F
SERUM P. INFANTS (HESS AND LUNDAGEN) (Low P = RICKETS) G
WEIGHT OF SCHOOL CHILDREN % NOT MAKING EXPECTED GAINS. J
DEATH RATE per 100,000, CLEVE. 4 YEARS. H
SERUM P. ADULTS (PRICE) I
PNEUMONIA CASES, CLEVE. 1926. F
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan

Fig. 1.—Seasonal periodicity in vital factors. Series of ten graphs showing evidence of annual cycles. *A*, composite graph of the product of serum calcium and serum inorganic phosphorus of about 500 patients, covering a period of 4 years. *B*, a similar study for serum calcium. *C*, days care of medical cases in sixteen Cleveland hospitals. *D*, serum calcium of infants, January to June as compared with October to December inclusive. *E*, death rate per hundred thousand in the United States, 1920 to 1925. *F*, pneumonia cases in Cleveland for 1926. *G*, serum phosphorus of infants. *H*, death rate per hundred thousand in Cleveland for four years. *I*, serum inorganic phosphorus of adults for 4 years. *J*, the percentage of school children not making normal expected gains in winter and spring as compared with the fall.

north temperate zone in the winter and spring. The incidence of pneumonia, for example (Fig. 1), in Cleveland in 1926 dropped from 83.8 per hundred thousand of population in March to 5.3 in August. Erysipelas varied from 4.8 in April to 0.6 in August; which indicates a difference in general defense to bacterial invasion from organisms which probably attack the body when it has lost its maximum defensive ability, which we speak of as immunity.

That there are cycles in a number of our physical factors has been demonstrated. Seidell and Fenger[2] have shown that the iodin content of thyroid glands of sheep and pigs is about three times as much for the months from June to November as for the months from December to May. Malling-Hansen and others have shown the growth of children to be more rapid in the spring and summer than in the winter.

An important contribution to this phase has been furnished to me by the Department of Physical Welfare of the Cleveland Board of Education. They have given me data obtained from the study of two schools in Cleveland where determination was made of the percentage of children making expected gains in weight in each of two periods, September to January, and February to June. These children were divided into grades and averages made for all grades and for each school separately, and then for the two schools combined. These data reveal that only 32 per cent of the children studied in both schools, representing 1,429 pupils, made the expected gain in weight in the spring; whereas, in the fall period, there was a gain of 64 per cent. This is shown graphically in Figure 1, *J*.

2. Seidell, A., and Fenger, F.: Seasonal Variation in the Iodine Content of the Thyroid Gland, J. Biol. Chem., 13:517, 1913.

One of the disturbances showing marked seasonal expression in the north latitude of America is the development of rickets in children under 2 years of age. It has been demonstrated that 90 per cent of all children under 2 years of age in the large cities of that zone have some rickets if not treated with sunlight or artificial light, or with vitamin D. This condition has its expression largely in conjunction with the depression of the inorganic phosphorus of the blood. This affection usually is cured spontaneously in the summer and early autumn. Hess and Lundagen,[3] writing on artificial radiation, state: "In this connection, it is well also to bear in mind that rickets and tetany are almost nonexistent in the tropics." These authors present data under the title, "A Seasonal Tide of Blood Phosphate in Infants," in which they indicate a level of 4.3 for phosphate in June and July, 1921; 3.95 in December; 3.9 in January; 3.75 in February; 3.58 in March, and rising progressively to 4.22 in June. These figures are shown graphically in Figure 1, *G*.

In a group of somewhat older children, they found the averages to vary in the same direction, but to a smaller extent.

Disturbances in the level of calcium in many animal forms result in tetany if the fall is too great. Bakwin and Bakwin[4] have presented data under the title, "Seasonal Variation in the Calcium Content of Infants' Serum," in which they have studied a large group of infants through several months and have presented the mean for these in chart form. They found, in general, that the calcium tended to be low in February, increasing progressively to June, and was at the highest

3. Hess, A. F., and Lundagen, M. A.: A Seasonal Tide of Blood Phosphate in Infants, J. A. M. A., 79:2210 (Dec. 30) 1922.

4. Bakwin, Harry, and Bakwin, Ruth Morris: Am. J. Dis. Child., 34:994 (Dec.) 1927.

inclusive. *E*, death rate per hundred thousand in the United States, 1920 to 1925. *F*, pneumonia cases in Cleveland for 1926. *G*, serum phosphorus of infants. *H*, death rate per hundred thousand in Cleveland for four years. *I*, serum inorganic phosphorus of adults for 4 years. *J*, the percentage of school children not making normal expected gains in winter and spring as compared with the fall.

point recorded in October, from which point it progressively decreased to February, the range being from 8.4 in February to 10.9 in October. These data are expressed graphically in Figure 1, *D*.

I presented data[5] before the American Association of Medical Milk Commissions, Inc., Montreal, June, 1929, comparing mortality rates for four successive years in Cleveland in order that an observation may be made on the general similarity for different seasons. A curve for this is presented in Figure 1, *H*, showing the death rate per hundred thousand in Cleveland. From this, it will be seen that the high point for mortality is in March, with April nearly as high, but with a progressive monthly decrease through to September, when it rises again through October, November and December. Similarly, I am presenting a graph of the mortality rate, which is shown in Figure 1, *E*, per hundred thousand for the United States for the years 1920 to 1925 inclusive. It is of interest to know that the peak for most of the country comes in February, with the low point again in September, and a rapid increase to December.

Another important phase of this problem has to do with the seasonal cycle of development of degenerative processes in adults. I have presented data in many of my reports indicating a relationship between imbalances in the chemical constituents of the blood and these disturbances. There are many expressions of these affections, some being local in the mouth as a tendency to dental caries, others as a tendency to the development of pyorrhea, often in association with general systemic decalcification of the skeleton, and with expressions of disturbed function of one or several organs of the body. I have also presented data indicating that some of these factors are directly influenced by

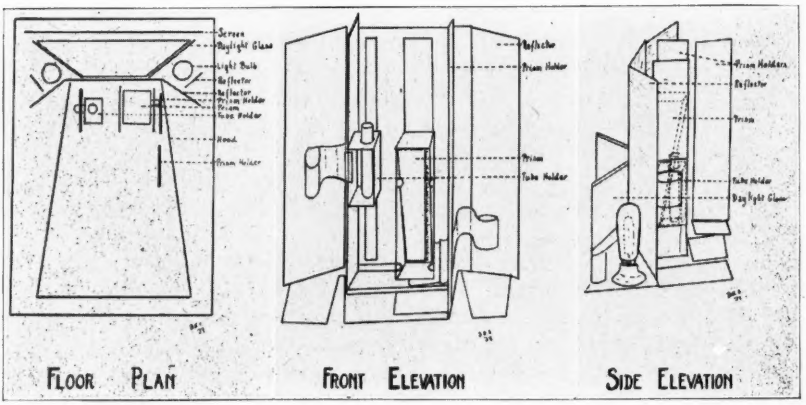

Fig. 2.—Author's instrument for making the vitamin A test, the color tone of which is transient.

5. Price, W. A.: Calcium and Phosphorus Utilization in Health and Disease. I. The Rôle of the Activators for Calcium and Phosphorus Metabolism. II. The Nature and Source of Calcium and Phosphorus Activators. III. Seasonal Variations in Butter-fat Vitamins and Their Relation to Seasonal Morbidity, J. Certified Milk, October-December, 1929.

toxic material from focal infections, particularly infections such as dental in bone, and further that defense against focal infections is directly influenced by these chemical imbalances.

As an aid in my diagnostic procedures, I have included, during the past seven years, a blood chemical study, having now 1,800 sets of blood chemical determinations, many of which have been made at different times for the same individuals while under operation and during treatment. When these data have been projected in chart form, there has been disclosed a cycle. For these graphs, I have used determinations of approximately 140 patients a year for four successive years: 1926, 1927, 1928 and eight months of 1929, having a total of about 500 cases. These curves, represented in Figure 1, *I, B* and *A,* show, respectively, the averages for the inorganic serum phosphorus, the serum calcium and the product of serum calcium and serum phosphorus, the last of which at normal should be approximately 40. It will be seen that a distinct seasonal cycle is expressed, with its maximum depressions in December, January and July, and with the peak in June, September and October.

Similarly, curves might be added for the development of epidemic infections such as colds and influenza. Enough has been shown to indicate a marked annual cycle in morbidity and mortality both, as relates to certain of the infectious diseases, particularly respiratory and nutritional disturbances. These indicate a general maximum of susceptibility for the north latitude for the late winter and early spring months, with the minimum of susceptibility for the summer and early autumn.

A new condition has obtained in recent years in that fewer individuals are dying of epidemic contagious infections and more of degenerative processes through the breaking down of one or more of the organs or groups of tissues of the body. The indications are strong that individuals do not die so much because they get diseases as that they get diseases because they are in the process of dying. The data from researches that I am herewith reporting suggest that the seasonal tides of regeneration and degeneration are directly related to functional causative factors, part of which are found in the seasonal tide of activators in the available foodstuffs.

VITAMINS IN IMMUNITY AND GROWTH

A striking advance in knowledge regarding the factors involved in immunity has been the discovery of the rôle of the vitamins. While vitamin A has a marked influence on growth, perhaps even this is not considered to be so important a discovery as its influence on the defense of the body against infection, particularly infections of the respiratory system. The absence of vitamin A is attended with a decrease in the rate of growth, and the development of a severe disturbance of the eyes known as xeropthalmia, which may result in the destruction of the function of the eye. But this injury seems to be largely the result of the bacterial infection which develops because of the lack of immunity. All epithelial tissue seems to be influenced directly by the absence of this activator.

Similarly, an absence of the antipellagric factor, vitamin F (formerly B_2), produces marked changes, both physically and functionally, in the intestinal tract, one of the characteristics of which is marked in the susceptibility of this tract to invasion. Another striking characteristic is the effect of vitamin D, which is usually thought of as being important in the prevention of rickets. This activator

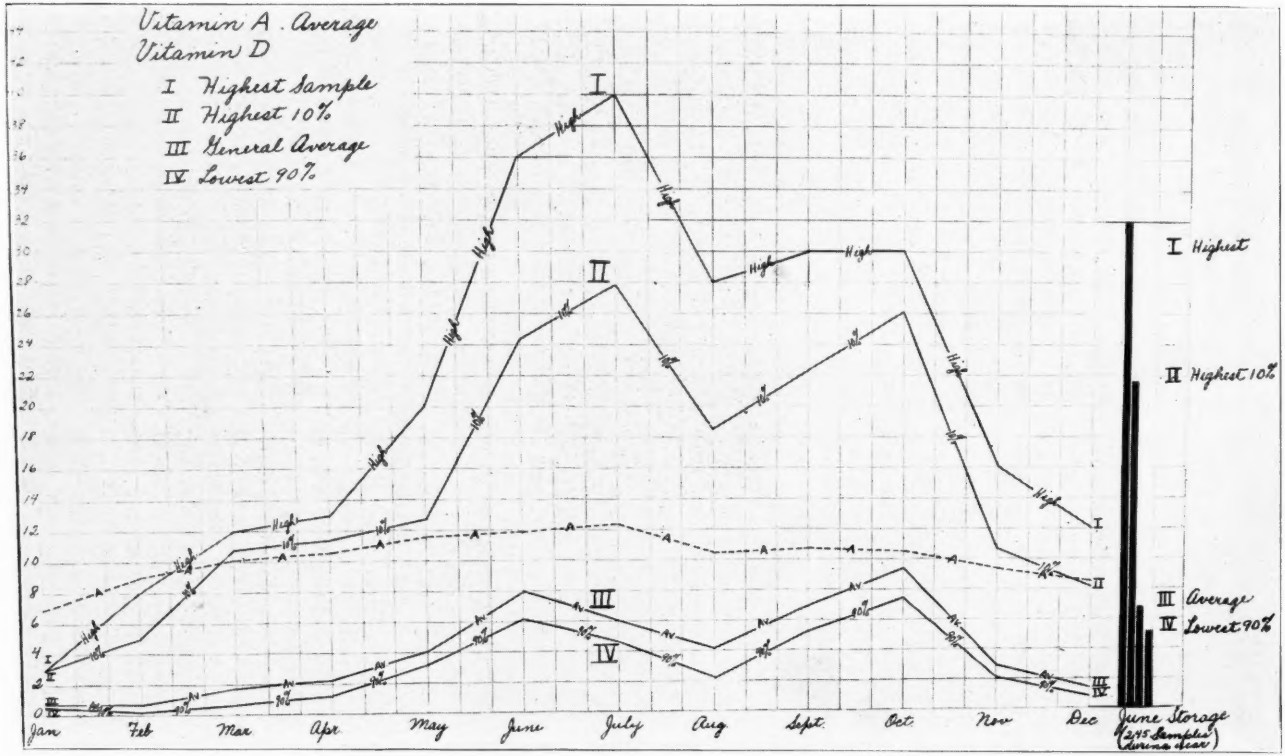

Fig. 3.—Monthly variations in the levels of vitamins A and D in butter from five states during 1928. Vitamin A is shown in the dotted line; vitamin D in the solid line in 4 percentages: (1) highest 1 per cent; (2) highest 10 per cent; (3) general average; (4) lowest 90 per cent. The solid vertical lines at the right indicate the same factors for June storage butters as tested the following winter.

is able to produce marked changes in the hydrogen-ion concentration of the intestinal tract, which largely determines the type of organisms that can proliferate. This vitamin has also been shown to have a marked influence on the metabolism of calcium and phosphorus as well as in their deposition in normal and abnormal calcification processes. The absence of this vitamin, and probably some other activators which are associated in the process, compels the organism to take calcium and phosphorus and probably some other substances from the storage depots of the body for use in the functional processes, in which rôles some of it is lost by excretion. I interpret my research data as indicating that one of the important factors in the degeneration of organs and tissues is associated with this general phenomenon of overdraft on the storage of calcium and phosphorus.

We are all familiar with the commonly recognized problem that in elderly people broken bones do not always readily heal. It has not been appreciated that these bones break largely because they have been weakened from within and further that they do not heal or unite because of the stress produced within the body by the establishing of that condition which produces decalcification. In my studies of these problems of calcification disturbance, I am frequently asked to assist in the management of cases of ununited fracture, and it has been most gratifying to find that in many of these cases, complete union is often brought about quite readily, when a negative calcium balance is changed to a positive. It is also of interest that blood chemical analyses will generally disclose whether or not the broken bone would heal readily.

I have discussed this at some length,[1] showing that as the chemical conditions of the blood improved, there was not only the union in fracture which had existed over a period of nine months in a woman 74 years of age, but also that there was roentgenographic evidence of a marked increase in the cortical layer of the bone in the short period of twelve weeks following treatment by increasing the available activators. This condition occurs in young people as well as old. It much more severely affects people beyond middle life. My data indicate to me that it is an important factor in the development of the essential constitutional phases of the so-called horizontal type of pyorrhea. These individuals are, in a sense, literally burning their furniture, because they cannot take from the food, even though the elements are present in the food, an adequate quantity of calcium and phosphorus for the anabolic and katabolic processes of the body.

We are coming to appreciate that the skeleton is as important as a storage depot for the readily available supply of calcium and phosphorus for the fluctuating demands of routine life as it is as a framework. Many forms of sea life maintain storage depots in their shells, just as a bird's egg provides the calcium for the developing birdling as well as for protection. These depots are necessary because of variation in the available supply of those other products in the foods and because of variation in the supply of the necessary activators for obtaining them from the food. The ignition system is necessary as well as the fuel.

It has been known for some years that the more foods were purified, the shorter would be the period for which they would maintain life. It has also been known that certain vegetable and animal products could not, of themselves, maintain life, but would do so with a minute addition of some other animal product. For example, the laws have required that oleomargarin

The solid vertical lines at the right indicate the same factors for June storage butters as tested the following winter.

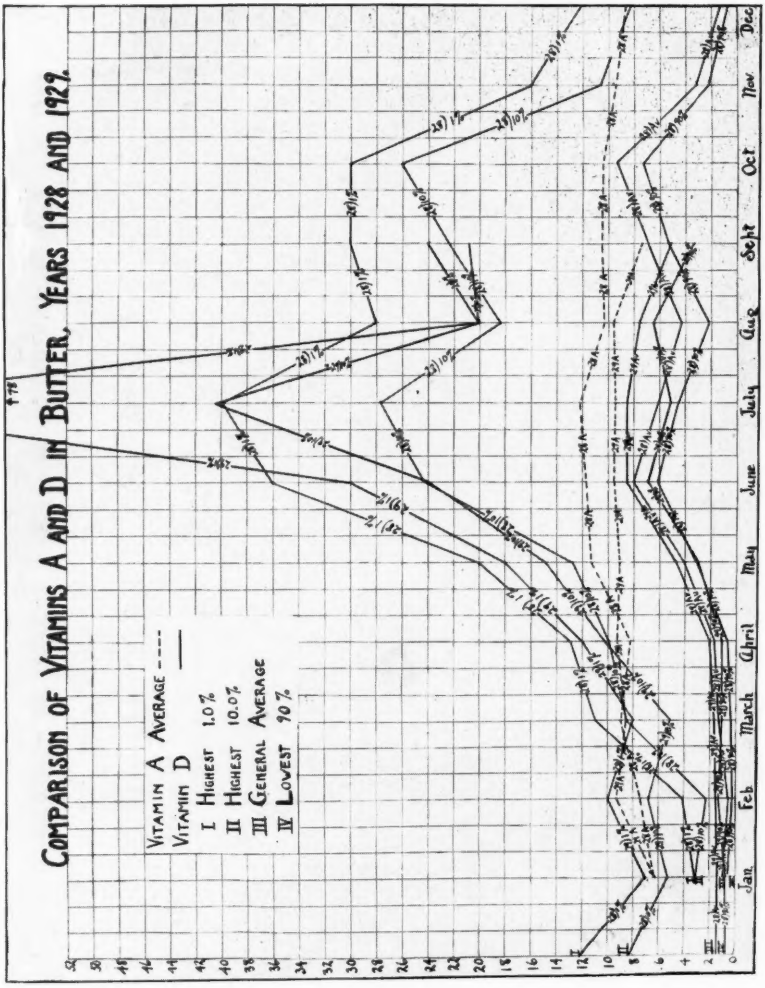
Comparison of Vitamins A and D in Butter, Years 1928 and 1929.
Vitamin A Average ----
Vitamin D ——
I Highest 1.0%
II Highest 10.0%
III General Average
IV Lowest 90%
Jan. Feb. March April May June July Aug. Sept. Oct. Nov. Dec.

Fig. 4.—Comparison of the levels of vitamins A and D in butter in 1928 and 1929. *I*, the highest 1 per cent; *II*, highest 10 per cent; *III*, general average; *IV*, lowest 90 per cent. (Five state area.)

carry a certain percentage of butter because it was known that alone, under certain conditions, it could not maintain life. With the addition of but 25 per cent of butter, it is life sustaining and will insure growth.

It has not been appreciated to what extent these vitamins were present in the butters used to vitalize the oleomargarin, nor the factors controlling the variation. It is now recognized that human beings cannot, and probably few of the other animal forms can, develop without the presence of an adequate supply of vitamins. Some of these are quite readily provided in the vegetation, particularly vitamins B, C and E, and in some instances A. It is probable that there is greater general stress due to the absence of vitamin D than any other of the known activators because of its scarcity. The civilizations of the world have been built around three principal sources of food; namely, dairy products, sea foods and leafy vegetables. Some communities have had all three, but most communities have depended chiefly on either dairy products or sea foods. A few have had to depend, in considerable part, and usually with great difficulty, on obtaining these vitamins from the sterols of vegetation, particularly of special plants.

American civilization is built largely around the dairy cow as a source of vitamin D and, in a lesser degree, as a source of vitamin A. All mammalian forms are dependent on milk as the principal or sole source of nourishment for the early period of extra-uterine life. In the United States, we maintain, approximately, 25,000,000 dairy cows, or one for every five of the population; approximately eight for every square mile of the habitable country.

The dairy industry constitutes one of the great enterprises of the United States. Approximately forty cents of every dollar that is earned in wages and salaries in the United States goes to buy food; which amounts to about two billion dollars; and probably more is expended for milk and milk products than for any other food. On the basis of its merit and efficiency, this is as it should be and this is probably not so large a sum as it will become with the knowledge and means for increasing the food value of dairy products through an increasing of the vitamins. In my researches on means for preventing dental caries and improving calcification processes, I have been impressed not only with the structure of the teeth, but also with their freedom from dental caries in people who have come from certain communities, as, for example, some places in southern Europe, and we have observed that when these people came to America, this immunity was lost, often within a year or two and that, particularly under stress of overload, they have developed caries. This has been more noticeably true of growing children and in motherhood and during the lactation period. It is particularly significant that, in some districts, women will be relatively immune to dental caries throughout the child-bearing period; while, in certain other districts, their immunity may be adequate or nearly so up to the child-bearing period, and then be lost.

We should have these and similar data in mind when considering the importance of the activators in various foods, especially dairy products. Most people are familiar with the fact that some mothers cannot efficiently rear their own infants on the breast-food that they produce. Probably, few people having no direct contact with the dairy industry have been familiar with the difficulty that is sometimes encountered in raising calves on their own mother's milk, while the milk of some other cow will be entirely effi-

cient. Similarly, it is a matter of common knowledge that infants and growing children do not thrive well on the milk of some cows but do on that of others. By ordinary chemical analyses, these different milks are often found to be comparable; indeed, the milk that is unsatisfactory may have a higher caloric value than the one that is satisfactory. With the development of biologic chemistry, particularly in conjunction with the study of the vitamins, it has come to be quite a common practice to use dairy products as a source of essential food elements, usually, if not generally, with the presumption that milk is milk and butter is butter, and, therefore, one is quite as good as another.

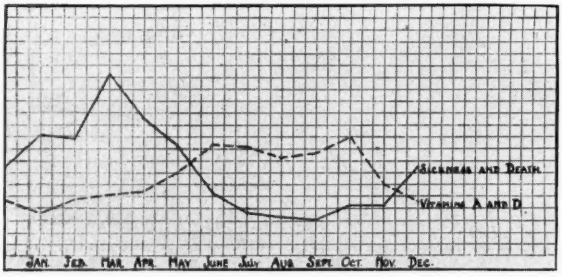

Fig. 5.—Comparison of the graph for the vitamin levels with that for the morbidity levels by months. The latter is the reverse of the former.

An interesting observation was made by McCollum, Simmonds, and Becker, under the title, "Studies on Experimental Rickets; Variation of Vitamin D Content of Butter Fat as a Factor in the Development of Rickets Induced by Diets Suitable for Preparing Rats for the Line Test."[6] They found, in using the same formula in two different periods of the year, where apparently the only difference was the butter fat sample, for the quantity of butter was the same, that there was a marked difference in the effect of the diet. In one series of experiments, these diets produced marked deficiencies in the bone structures in twenty-five days; whereas, they would usually not be ready for the line tests for about from thirty to forty days. In a series of experiments run in the autumn of that year, the same quantities of butter from a different source being used, the bones were almost normal in structure. The authors state: "Since we have chanced to use a sample of butter fat which contained more than the usual amount of vitamin D, we publish this brief account of our experience in order to point out the necessity of keeping the butter fat content of the diet as low as possible, since this may in certain cases be a disturbing factor."

Some important work has been reported by Luce on, "The Influence of Diet and Sunlight upon the Growth-Promoting and Anti-Rachitic Properties of the Milk Afforded by a Cow,"[7] in which she states: "Milk from the same cow has been shown to vary within wide limits, as regards its anti-rachitic and growth-promoting power. A possible contrib-

6. McCollum, E. V.; Simmonds, Nina; Becker, J. E.: J. Biol. Chem., 70:437-438 (Oct.) 1926.

7. Luce, E. M.: Biochem, J., 18:716-739, 1924.

utory cause of the seasonal incidence of rickets in children may be the use of milks whose anti-rachitic value is higher in summer than in winter." She states further: "The anti-rachitic value depends on the diet of the cow, and possibly also on the degree of illumination to which she is exposed. Milk from a pasture fed cow has a definite and high anti-rachitic value; the same animal when stall fed in the dark, yielded a milk much inferior in anti-rachitic properties."

She later reported a continuation of these studies,[8] concluding as follows: "These further observations show that sunlight, of summer intensity in this country (England) has no significant effect in raising the growth-promoting value of cow's milk, when the diet of the cow is deficient in fat-soluble vitamins. The degree of exposure to sunlight appears, however, to have a small effect in determining the anti-rachitic value of the milk given."

Chick and Roscoe reported[9] experiments made in continuation of those by Luce, which in part were as follows:

> The vitamin A content of the milk was found to be dependent on the diet of the cow, being at a maximum when the cow was fed upon fresh green food and least when the cow received a winter feed of cereals and roots.
>
> The degree of exposure of the cow to sunlight had no influence upon the vitamin A value of the milk. When the cow received fresh green fodder in a dark stall the vitamin A content of the milk reached its maximum and no further increase was noted when the cow subsequently went to pasture.
>
> The anti-rachitic value of the milk (vitamin D content), on the other hand, was found to depend principally upon the degree of insolation of the cow. This result was obtained from experiments in which the rickets-preventing power of the milk (1) was estimated from the growth-promoting power of the milk and (2) was measured by its capacity to prevent rickets in rats receiving a low phosphorus rickets-producing diet.
>
> At the same time there was some indication that the diet of the cow, if consisting of fresh green food, was a contributory factor. Our experiments confirmed those of Luce in showing that "pasture-fed" milk possessed the maximum anti-rachitic value while that yielded by the cow when receiving a diet of cereals and roots appeared on the whole inferior in this respect, in spite of exposure to maximum illumination out of doors in summer.

While it has been suggested, by the work of McCollum and his associates, that there is a great difference in butters as regards antirachitic factors, and by Luce and later by Chick and Roscoe that diet and exposure play important rôles in the development of vitamins in milk fat, there have not been, to my knowledge, any data available as to the relative value of butters from different sources at different seasons, which has been the reason for my undertaking this task. It is apparent that no comprehensive effort has been made to determine the influence of seasonal factors on the various degenerative processes or their influence on the production of activators in foods on which most animal life is helplessly dependent, but by which a sufficiently informed society might be able to find means for reducing morbidity through use of the products obtained by adapting a knowledge of these forces to its needs.

Since the vitamin content of foods is coming to be recognized as quite as important as the energy-producing factors, and since the calcium and phosphorus activators have proved to be so scarce, I have had the conviction that the vitamins in the butter fat of milk not only have supreme importance for the quantities we may now obtain from that source, but that it might be possible greatly to en-

8. Luce, E. M.: Biochem. J., 18:1279-1288, 1924.

9. Chick, H., and Roscoe, M. H.: Biochem. J., 20:632-649, 1926.

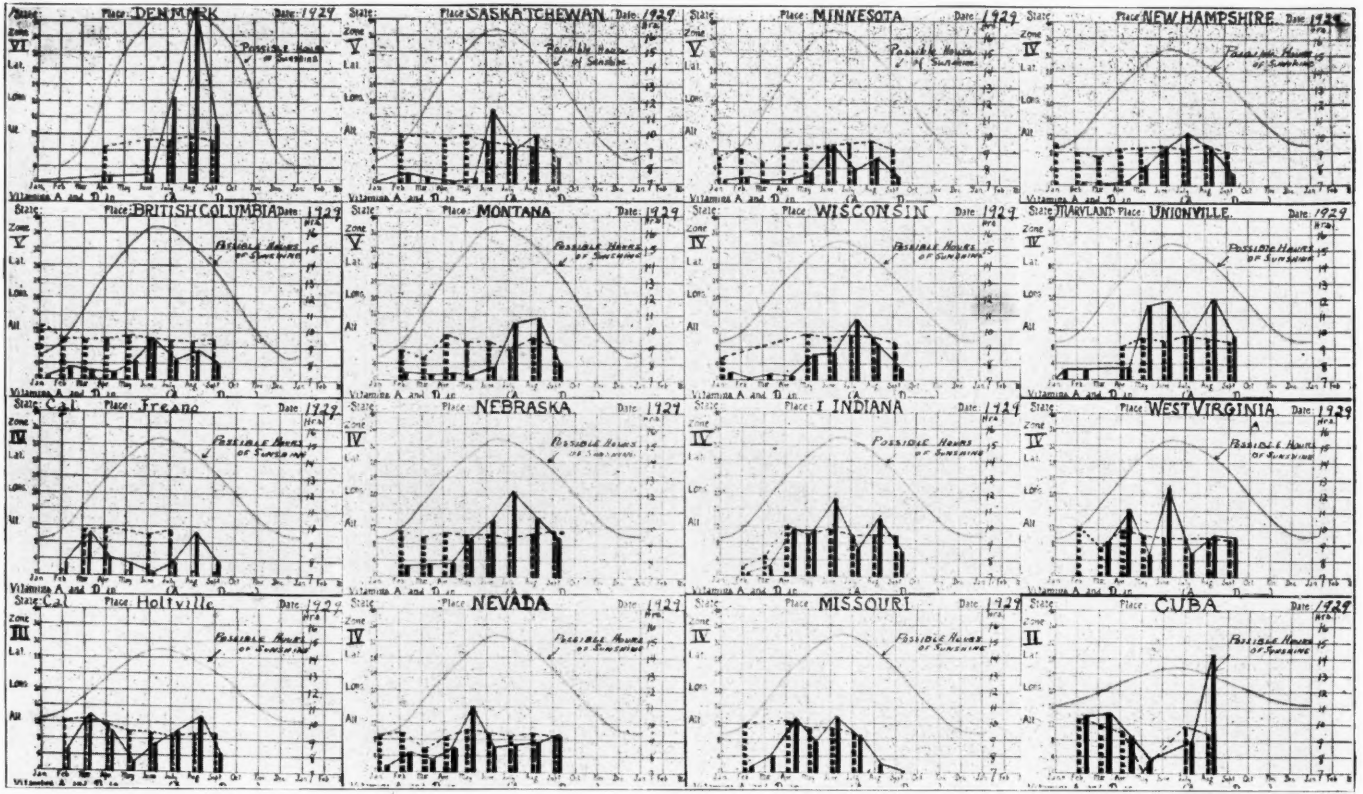

Fig. 6.—Monthly variations in vitamin A and D levels in butter for sixteen states, provinces or countries for 1929, January to September inclusive. Vitamin A is shown in the broken lines, D in the continuous lines. Zone II is latitude 15 to 25; zone III, 25 to 35; zone IV, 35 to 45; zone V, 45 to 55; zone VI, 55 to 65. This is presented as typical of the entire area covered in these studies by analyzing samples, which come on an average of every two or three weeks from more than 400 places.

hance or increase the value of milk by increasing its vitamin content. A search of the literature disclosed practically no dependable data as to the amount of the fat soluble vitamins A and D in milk fat under different conditions, such as seasonal, and the environmental conditions of the animal producing it, including climate and available ration, or the species of the animal.

In order to obtain data on the amount of vitamins in this most nearly universal mammalian food source of vitamins A and D, I have undertaken, during the past five years, to make determinations on a large number of samples of butter and milk, with a view to determining both the chemical constituents and the vitamin content and the influence of certain foodstuffs and radiation on the vitamin content.

In a paper read before the International Dental Congress in 1926 at Philadelphia,[10] I presented considerable data dealing with the chemical content of the blood and the milk of cows, with and without special treatment, and also with the effect on chickens of the milk produced under different conditions. These early studies were dependent entirely on the feeding of the products to animals for the purpose of evaluating the level of the vitamins. With the advent of colorimetric methods for the determination of vitamins A and D, these have also been utilized. Among these methods is the antimony trichlorid method of Carr and Price[11] and the hydriodic acid method of Yoder.[12] Comparisons have been made by several persons as to the relative merits of these methods, and they have been found, in general, to check within 10 per cent, and with some workers, the results have been much closer than this.

In a study of the value of the animal assay method, McCollum and Adams[13] have published a lengthy investigation in which they have come to the conclusion that this method is not an accurate means of assaying vitamin D in cod-liver oil. A part of their conclusion is as follows:

1. The data obtained in this investigation do not bear out the anticipated possibility of determining the anti-rachitic potency of cod liver oils by following changes in bone composition.

2. Blood analyses calculated to give the ion product values CaPO indicate whether test animals show active rickets or healing.

3. Indications such as given by results of blood analyses can be correlated with line test (i. e. histological) observations in practically all cases. The line test picture as evidenced by the majority of a group of ten or fifteen animals should be indicative of the potency of a given oil.

4. Cod liver oils do vary with respect to their content of antirachitic vitamin.

CONCLUSIONS

1. Application of the above method to assay of cod liver oil gives data which can be interpreted to indicate only relative potency of oils. Absolute comparison to the point of establishing so many arbitrary units of antirachitic factor per given weight of oil is not justified on the basis of data of the type obtained.

2. A given procedure is no more accurate than the least accurate of the factors involved; in particular, biological behavior, valuable as it is in indicating the general trend of results, is not subject to mathematical accuracy. It is the writers' opinion, therefore, that no biological assay with respect to the vitamin content of given substances will yield more than relative values.

3. The dosages ordinarily indicated, and the time period usually involved in the utiliza-

10. Price, W. A.: Calcium, Its Activation, Utilization and Metabolism, J.A.D.A., 15:729 (April) 1928.

11. Carr, F. H., and Price, E. A.: Biochem. J., 20:497-501, 1926.

12. Yoder, L.: J. Biol. Chem., 70:297 (Oct.) 1926.

13. McCollum, E. V., and Adams, G.: J. of Biol. Chem., 78:495 (July) 1928.

zone VI, 55 to 65. This is presented as typical of the entire area covered in these studies by analyzing samples, which come on an average of every two or three weeks from more than 400 places.

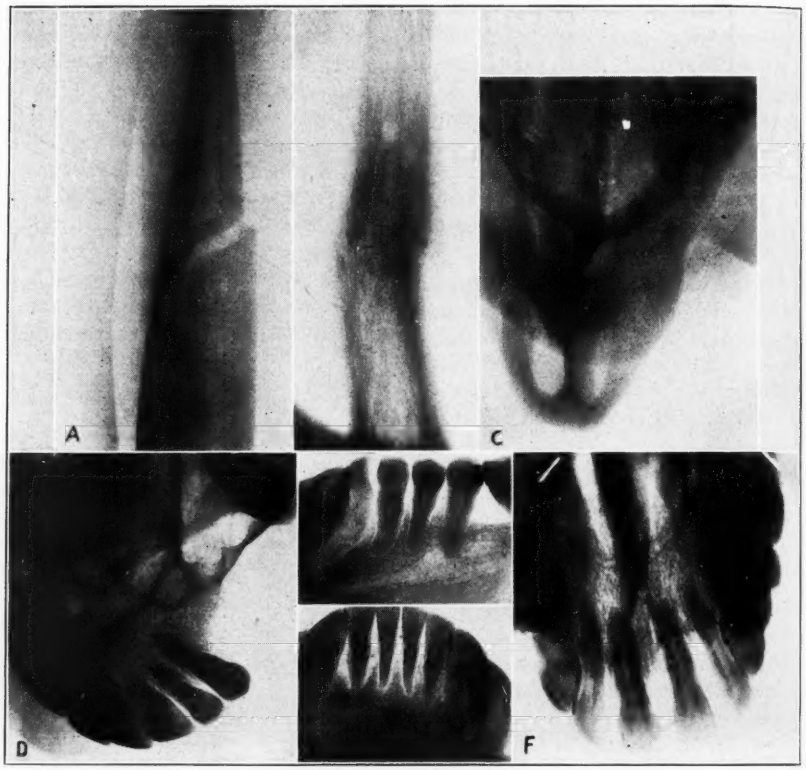

Fig. 7.—A series of decalcification disturbances (patients all showing negative calcium balance). *A*, ununited fracture after twelve weeks; no callous formation. *B*, same three weeks after starting treatment, showing excellent callous formation. *C*, marked alveolar decalcification, showing slight difference between density of hard and soft tissues. *D*, decalcification with enlargement of maxillary sinus and loss of alveolar ridge, with marked thinning of floor of sinus. *E*, above, reduced density with loss of trabeculae in mandible; below, loss of supporting alveolar process, both due to systemic decalcification. *F*, loosening and movement of upper teeth from pressure of lower, due to systemic decalcification (patient, aged 22).

tion of cod liver oil for prevention or cure of human rickets, admit of a sufficient factor of safety that it is probable that any of the better grades of oil upon the market afford protection.

In these studies, I have used both methods and have found great value in the colorimetric method for evaluating vitamins A and D in butter fat. Since the blue produced by the use of antimony trichlorid for the vitamin A test is very transient in some instances, the matter of making comparisons with standard colors constitutes a real problem. I have reduced this problem by devising a colorimeter that allows readings to be made quickly. This instrument (Fig. 2) is relatively simple in construction.

The plan for this research has been as follows: I obtained, during 1927, samples of butter from a few states and made tests using both animal and colorimeter procedures. During 1928, I extended this work to include a better representation of the five states. Butters were obtained from the same sources, when possible, throughout the entire twelve months of the year, from January to December inclusive, at fortnightly periods. Analyses were made of vitamins A and D in approximately 1,300 samples of butter during that year. Some of these butters were obtained directly from the creameries; others were purchased from wholesale distributors of dairy products, from the same source each time. The units that I have used will later be expressed in terms of other adopted units. The result of that study will be seen in Figure 3, "Vitamins A and D in butters by months, 1928." In this chart, several factors are represented. The determinations are shown from January to December for both A and D. There is only one graph for vitamin A, which is the broken line extending across the sheet, curving upward with the approach of summer and downward during the autumn and winter, with a depression in each April and August. Vitamin D is shown in four quantities for each month; (1) the highest 1 per cent; (2) the highest 10 per cent; (3) the general average; (4) the lowest 90 per cent.

Clearly, the majority of people would have to depend on the 90 per cent quality; and, in these experiments, practically none knew whether they were using the poorest or the best butter with regard to these vitamins. It is particularly tragic to note how low vitamin D was found to be in 90 per cent of the butters throughout January, February, March and April and the following December. Beginning in April, a sharp rise occurred in all the vitamin D measurements, a peak being reached in June, at which time vitamin D was more abundant, many times over, than during the winter and early spring months. July and August showed a progressive decline, and September and October, a progressive increase; with a rapid decline in November, reaching a low level in December.

During this period, determinations had also been made as to the vitmain content of a storage butter that was being sold as cooking butter, since the law of this city, as in many others, requires that storage products shall be so labeled, and they are, therefore, always regarded with prejudice. During this period, it was found that some samples of the storage June butter of the year before, 1927, were very high in vitamin content, others medium and others moderately low. These studies of the storage June butters are shown at the extreme right of Figure 3, and it is of particular interest to note that, when divided into the same four groups on the basis of vitamin D, namely, highest 1 per cent, highest 10 per cent, general average and lowest 90 per cent, these factors checked relatively closely with the readings obtained for the fresh June butter which was made in June, 1928, which suggests, if it does not indicate, that the storage of the butter had not diminished the vitamin content.

This is a matter of importance, and one which I will discuss further later. These data seem so clear-cut that they are evidently significant.

In order to increase the value of the data obtained by checking the probability that they indicated conditions that are related to seasonal changes, rather than groups of influences which were generally local and incidental to the climate over a particular season, I purposely did not

publish these data until I might add to their value by obtaining a curve for another year, not only for the same districts, namely, five states, but also for a much larger field, in order that latitude, as well as available sunshine, might be studied in relation to local contributing factors such as altitude, soil, precipitation and clouds.

We will all recognize that the characteristics of the climate of 1928 and 1929 for all parts of the year varied through a wide range as compared to each other. The remarkable paralleling of these two series of determinations is shown in Figure 4, in which it will be seen that the average amount of vitamin D provided in the butter of these five states, month by month, for 1929, is at a little higher level throughout the entire period, but is as nearly parallel as the tracks of an automobile up to June. It is not depressed in July, as in last year, but is lower in August than in July. We will readily recognize, in the climates of the two years, that July of 1929 was quite unlike July of 1928. I shall discuss this later.

It is also of interest to note the depression in vitamin A for March of this year and also that vitamin A did not increase through June and July of this year as it did in 1928. When we realize how many hundreds of determinations were made and also appreciate the significance of smooth curves, we cannot escape the conviction that we are dealing here with fundamental facts of almost incalculable import, for, in general, we are reproducing cycles which correspond with the cycles of morbidity which exist in human beings and in other animal forms. Immediately, we get the suggestion: Why not conserve the high vitamin product of June and October, or of such intervening months as may prove to be high, to tide over the periods of stress?

The similarity of the vitamin levels of these two years is more strikingly shown by comparison of the curves for all four percentages of vitamin D, namely, highest 1 per cent, highest 10 per cent, general average and lowest 90 per cent. The outstanding feature is that, in all grades, the averages run a little higher in 1929 than in 1928.

We will not readily appreciate the difference in food values of the high and the low samples of butter until we have an opportunity to see the difference in their effect on life. As foods have been, in the past, largely evaluated on their ability to produce energy or their caloric value, they would be relatively equal, but as a means of sustaining life, they are vastly different. I have already presented data bearing on these facts.[14]

A striking illustration of the conditions in the vitalization factors of different grades of butter on the basis of these chemical tests will be seen in the following:

An observation was made to determine the results of putting different groups of chickens under similar stress conditions and allowing them to eat all they wished of the special feed carrying vitamins A and D, as a means of maintaining life when on the deficient diet, McCollum's 3143, which is low in phosphorus but adequate in calcium. Some children do not have all they want of such as is available. These chicks did. The difference in the various groups consisted only in the quality of the butter as determined solely by chemical analyses of vitamins A and D. Twenty-five chicks were placed in

14. Price, W. A.: Calcium Metabolism Studies on the Nature and Rôle of the Activators; Researches on Fundamentals for the Prevention of Dental Disease, J. A. D. A., 16:265 (Feb.) 1929; Dominion Dent. J., October-November, 1929; Footnote 5.

each group, and each group had its own electrically heated brooder. All conditions were similar, with ample feeding trays of the same size, two automatic drinking fountains of the same size in each pen, sufficient room to permit running around and silica sand for scratching. Each group had two dishes of the same size filled every day with the kind of butter from which that group was to obtain vitamins A and D, except the limited vitamin A contained in the basic food. In one week, in group 1, receiving butters high in A and high in D, none were dead. In group 2 receiving butters high in A and low in D, 16 per cent had died, and in group 3, receiving butters low in A and low in D, 28 per cent had died. In nineteen days, the deaths were as follows: group 1, 24 per cent; group 2, 53 per cent and group 3, 72 per cent.

These butters were the pooled and graded products of various samples left over after our vitamin tests were made. They came, therefore, from a number of places, since each tube contained only about 5 c.c. when received, of which 1 c.c. was salt and water, or buttermilk. About 2 c.c. was to be used for making the tests, which left, on an average, about 2 c.c. excess for each sample. When we realize that these butters represent the dairy product of various sections of the country, we anticipate at once what a handicap individuals must receive who are compelled to use the lower grades of butter.

COMPARISON OF VITALIZING AND DEVITALIZING FORCES

Since life is a balance between a building up and tearing down of forces, with degeneration the ultimate result of the predominance of the tearing down forces, it becomes important not only to reduce the destructive forces, but also to augment, wherever possible, the constructive forces. I have undertaken to make a study of this aspect by reducing to a composite curve for the various months of the year the relative intensity of the various expressions of degeneration as shown in Figure 1, for morbidity, mortality, medical hospitalization, etc., and similarly I have made a composite curve for vitamins A and D for the years 1928 and 1929 to date as found in milk fat. These new curves are shown in Figure 5. Since these curves represent thousands of determinations, they are not dominated by incidental changes in a particular month in one factor or in one location. The curve for degenerative processes contains a national factor in the deaths by months for the United States for six years; whereas, the vitamin curve includes only A and D in milk fat and these only for five states in much the same latitudes. With the rapid fall in vitamins in November and December, individuals must draw on their reserves or storage vitamins and chemicals controlled by vitamins. This seems to tide them through the month to January, but the reserve is exhausted by February, so that many of them have broken sufficiently, either by loss of immunity or advance of degenerative processes, that they find themselves in need of hospital care. Many, if not most of these, have realized a reduction in their factor of safety through a feeling of loss of energy so that, by the end of March, large numbers have become bedridden or sufficiently indisposed to need hospitalization. With a marked increase in disturbances during February, March and April, the provitamins are steadily decreasing in the food products, for we probably may assume, though we do not have data to demonstrate it, that what is occurring in vitamins A and D owing to the absence of the vitalization factors of freshly grow-

ing vegetation for the cows, is also occurring with the vitamins from similar causes, since they too are largely the product of plant life, though some are stored in animals eating the plants and, in a small extent, synthesized by some animals when on a plant ration.

Concurrent with this sharp rise of the vitamins in April, May and June, there is a sharp fall in morbidity, and with the return of these vitalizing factors by July and August, morbidity has been greatly reduced. With the coming of the hot weather, there is a secondary depression of the vitamins more or less severe, according to the local conditions. Again, individuals are thrown somewhat on their reserves, which they soon diminish or exhaust, and, by September, they are losing their defense; which is expressed in this curve in an increase in hospitalization during October. Fortunately, there is an increase in the available activators or vitamins in October, which reaches a higher level even than the June peak, and the morbidity line straightens out. This October rise in vitamins is short, the peak being reached at varying times in different parts of the country according to local conditions. Consequently, there is a rapid fall of the vitamin levels through November and December, but again we see the fall in morbidity, the rise occurring sharply during December and January.

Probably, one of the principal reasons why progress in the reduction of the degenerative diseases has been so slow has been that the cause has been searched for by studying the effects. With the rapidly accumulating newer knowledge regarding the activating substances, some of which are recognized and identified as vitamins, a new approach has become possible through a study of the causative factors and an intensive study of the vitalizing factors. This puts more and more emphasis on studying the individual with regard to his varying capacity to maintain immunity or to maintain organ and tissue function because of the presence in his system of forces which he must continually replenish from the often scant sources, since they are apparently ultimately the product of radiation energy in conjunction with plant and animal life, chiefly the former.

There are two conditions which are so important that they should, if possible, have much more extended consideration as a part of this message. The one has to do with the difference in the vitamin levels of different districts, on the basis of latitude, for the study of the effect of the approach of spring, and of longitude, for a study of geographic, environmental and climatic conditions in conjunction with latitude. The other is the desirability of presenting here concrete and clinical evidence that activators should be used as reinforcements for the available diet for reducing morbidity and degeneration, not only general, but also for this group particularly in the dental and oral field. I can present, at this time, only one illustration of each. I have unpublished data on both of these subjects, and this information will appear with a general discussion of this entire problem as early as is feasible after the completion of this year's curves for the vitamins.

In Figure 6 will be seen reproductions of the 1929 vitamins A and D curves by months for sixteen states, provinces and countries. In part, these are arranged according to latitude, that is zone II includes latitude 15 to 25; zone III, 25 to 35; zone IV, 35 to 45; zone V, 45 to 55; zone VI, 55 to 65. I have not included South American countries, Alaska or Honolulu, but only a few of the states, provinces and countries. On these charts

will be seen the curve showing the possible hours of sunshine, and it will be interesting, and no doubt a surprise to many, to see how much flatter the curve of hours of possible sunshine is in zone II than in zone VI; in other words, the daily hours of sunshine in the summer time are much greater as we go north in the northern hemisphere and the winter hours of sunshine are similarly greater as we go toward the equator. This is true also in the southern hemisphere, except that the seasons are reversed. It is particularly interesting to note that people who can afford to change their residence to points south in the winter and spring move northward progressively in midsummer as an essential health measure. The idea expressed in practically all of the literature has been that this movement has been primarily to obtain direct contact with the sun in the winter and spring and to escape the heat in midsummer. I wish to submit for consideration the evidence that one of the helpful facts and, indeed it may readily be the most important fact to be considered, has been the improvement of health through obtaining a higher level of vitamins in the available foods.

Immediately, we have the suggestion that greater effort should be made to provide foods of high vitamin content out of season as well as in season for each particular geographic location. All that will be required in most instances is the storage of at least part of the product at the time that the vitamins are high for use at the time when they are low in that district.

With regard to the matter of preventing degeneration and inducing regeneration, we are dealing with so many phases of life that it is exceedingly difficult to select one illustration which would represent even one phase, so I shall limit the general illustration of this phase to a composite one. One of the problems that intimately concern the members of this section has to do with bone regeneration following surgical procedures and trauma. *A* and *B* of Figure 7 show a fracture before and after the administration of carefully selected activators. At *A*, a young man, aged 28, had been twelve weeks under treatment for the healing of a fracture but without union. He had received large doses of cod-liver oil and liberal exposure to ultraviolet light from a mercury quartz lamp. The result (*A*) was complete absence not only of union, but also of formation of callus. *B* shows the condition four or five weeks after the patient was placed on activators, as determined on the basis of frequent blood chemical analyses. There is splendid callus formation. The activators used were a preparation made from a concentration of the vitamins of butter and a high vitamin cod-liver oil suitably activated, taken internally, and a specially activated cod-liver oil of high vitamin content, rubbed on the body. The total quantity of cod-liver oil taken internally was much less than at the preceding treatment. This phase deals directly with the rate of repair following surgical procedures, reduction of complications, such as hemorrhage and local infection, primarily due to increase of immunity to infection and improvement of clotting power of the blood.

One of the most difficult problems that present themselves to the general practitioner and also to the oral surgeon and diagnostician is the decision as to the program that is indicated for those patients with loosening teeth, with or without gingival infection and, if without, usually with gingival tissue still attached to the teeth, a condition which would usually be classified as pyorrhea. Suppurative infec-

tion may or may not be present, and the condition may advance in spite of persistent treatment and thorough home care. Such a case as I have in mind will be seen at *C,* Figure 7, in which roentgenograms of the tooth are shown, with its supporting structures. The maxillary sinus is separated from the mouth by a thin alveolar plate and, in the lower arch, it can readily be seen that the trabeculae have been largely removed by the process of decalcification from within. If these teeth are removed and dentures are placed, without a change in the systemic condition, progressive absorption will prevent the continued seating of restorations, with recurring perplexities to the prosthodontist. This patient's primary trouble is that her calcium balance is negative, and from day to day, it is necessary to take calcium and phosphorus from the storage depots of her skeleton because she does not get a sufficiency from her food. The product of serum calcium and serum phosphorus is 24.8 instead of 40; colesterol, 100 c.c., whole blood, is down to 60 instead of 150, and the cell volume is at 35 instead of 45. None of these conditions would be changed by any operation that would be done in the mouth, and the mouth condition can be largely corrected by proper systemic treatment through the administration of proper activators.

A similar case is shown in *D,* Figure 7. This patient was sent for special study because she had required five new plates in eight years. The maxillary bones cast little more shadow than the soft tissues of the nose. The recurring loosening of her denture ceased after she was placed on treatment for buidling up the hard tissues.

While these cases generally occur in people over 40 years of age, they often develop much earlier. In *E,* Figure 7, is shown a section of the upper arch of a woman, aged 22. These teeth are loosening from internal decalcification to such an extent that they are spreading out of the normal relationship and distorting the arch owing to the pressure of the opposing teeth, and all this notwithstanding excellent professional and home care. The serum calcium of this patient is approximately 20 per cent below normal. She urgently needs an increase in the amount of activators. These teeth tightened remarkably in sixty days.

If space permitted, I would also present data relating to the opposite phase of this problem, excessive calcification. In general, a number of the degenerative processes which we have thought to be disease processes are really symptoms of nutritional disturbance. Rachitic disturbances, attended with the rapid growth of childhood, when due primarily to a low phosphorus diet, readily cease when suitable activators are provided, either by rubbing them on the surfaces of the body or by changing substances already in the body into suitable activators by means of radiant energy. The convulsions in tetany of childhood and some phases of osteomalacia are due primarily to lowered calcium, and, frequently, show normal phosphorus levels, and the restoration of the calcium level with proper diet and proper activators completely remove the disturbances. Similarly, we have only to be reminded of the new point of view regarding infections of the mucous membranes of the body, particularly of the respiratory tract, and the important rôle of vitamin A in restoring immunity and for lessening or relieving some forms of neuritis not due to the absence of the antineuritic vitamin B_1. Likewise, dental caries will be found to be directly related to the absence of proper activators, which

is attended with the production of negative calcium balance.

The problems of adults are largely related to degenerative processes. It is my belief that we have been looking in the injured tissue for the cause rather than recognizing it as the effect, and I would quote from William Weston, who has expressed the view that caries and rickets, taken together, "constitute the greatest challenge to civilization of all problems with which we are called upon to deal." "We have about reached the conclusion," he says, "that their evils are the foremost enemies of the Nordic race in the temperate zone." I would add to this the large group of affections which, in adults, are associated with decalcification and which are not like the affections of childhood, for the bone has reached its growth. These studies are disclosing several of the contributing factors for normal development of the activators in foods.

SUMMARY AND CONCLUSIONS

Data from several sources which relate morbidity and mortality to monthly or seasonal variations have been here consolidated in a single graph. Data on the monthly variations in vitamins A and D in milk fat through a period of nearly two years for several communities, are here reduced to a single graph showing monthly values. These two composite graphs have been correlated and evidence has been presented regarding an important relation between the generative vitamin levels and the presence or absence of degeneration. Some of the physical expressions of decalcification have been indicated and the importance of a new point of view in the study and interpretation of degenerative processes is emphasized. These data indicate the need for a change of emphasis from consideration of the degenerative processes, whether of the oral cavity or other parts of the body as being primarily disease entities, to the consideration of their being largely the symptoms and effects of the absence from the body of activators (with or without a shortage of mineral constituents in the food), which are essential for the utilization of food elements. These degenerations are seasonal primarily because of the rise and fall, at different seasons, of the level of the activators in the foods, some of which are vitamins.

8926 Euclid Avenue.

DISCUSSION

F. R. Talley, Petersburg, Va.: I wish to make this plea that men in general practice give most serious consideration to this particular thing that Dr. Price has called our attention to, because it underlies the very foundation and the very success of the future generations. If you will study the conditions of the world over, as Dr. Price has pointed them out to you, you will find that people living on dairy products are generally well developed both in bony structure and the dental organs. Take those people of the Arabian desert who live on butter, sour milk, cheese and things of that kind and the green things that they find growing wild in their country, and you will find some of the finest specimens of humanity in the world, people of fine frame and fine teeth, and otherwise fine. Bring the same men to America, to our country today, and let them live under our conditions, and it will not be long before we find their teeth decaying, with probably arthritis and other ailments developing because of the fact that they cannot or do not get in our ordinary process of living the things that they need to keep up their body vitality and supply all of their tissues with the minerals necessary to their well-being. We are living today too much in tin cans. It is so easy to buy food and carry it home in the can. Then, we must recognize the fact that many of us when we were children, had the family cow, or the neighbor had one, and we got our dairy products from this source, raw milk and good, rich butter, and when conditions were not so crowded, the cow got the proper pasture and we had a sufficiency of vitamins A and D to supply the things we needed. But as we

have grown in population and have come to live in urban centers, it has become necessary to protect the health of our people, particularly against typhoid and tuberculosis, and so we resort to pasteurization of our milk, which, if I am properly informed, destroys vitamin C to a large extent. It is not the heat that destroys it, as I understand, but the oxidation of this vitamin. Then what do we do? Our children are getting a milk deficient in vitamins A and C, which stimulate the thyroid to better activity, thus promoting calcium metabolism, and today our children are not getting the proper amount of mineral salts to maintain bodily health, and the people themselves, not knowing these conditions, do not then add to their diet those green vegetables, lettuce, cabbage, oranges, grape fruit, carrots, all of which we could take raw and so make up for this loss of vitamin C in milk and butter. Therefore, I find among the younger generation a larger percentage of dental decay than we have noticed for a long time, and not until the general practitioner of dentistry realizes that this is partly his problem and that it is his moral obligation to acquaint himself with the physiologic factors that enter into the growth and maintenance of the child, is dentistry going to serve its purpose in serving its patrons. We must study this thing ourselves. Dr. Price has shown us the way as have many other men who are making these investigations, but there is a lack of interest shown by men in general practice. We are not willing to take the time to study this, and that is why physicians have not a higher respect for the dentist today. Let us lend our minds and hearts to the promotion of greater things in dentistry, physiologically, which are necessary to the maintenance of the health of our patients. These physiologic conditions must come first, and then mechanical restorations. The placing of fillings and things of that kind are secondary to the patient's good health.

Roy S. Hopkinson, Milwaukee, Wis.: Too frequently, we are inclined to say that we cannot make blood chemistry experiments and we have no one in our city that can do it. Two years ago, I was called in consultation regarding a multiple fracture of a mandible on one side. In other words, there was a fracture at the angle of the jaw and one anterior to the cuspid. We took care of this case in the usual way by the interdental wires, and in three weeks, constantly observing this case every day, I noticed that the lower bicuspid on the right side was apparently loose. Either the wire had slipped or the tooth had moved. Cutting these wires, I picked the tooth out by taking hold of a 25 gage wire. The patient was immediately sent to the x-ray room and, to my surprise, the mandible on that side showed definite evidence of a well-developed osteomyelitic condition. Three weeks later, we took another picture, and there was almost complete disintegration of the entire bony structure from the anterior fracture to the angle of the jaw, and each time that we took a picture, the case seemed hopeless. In the intervening time, the patient developed a general septicemia, with a high temperature and delirium a part of the time. The septic condition in the jaw was developing so rapidly that it seemed we would never be able to stop the infective process. Rubber drains were inserted and adequate drainage was established. Saline irrigation was used every hour, and I never saw a group of nurses more conscientious in taking care of this patient; yet we could not stop the process. Finally, the surgeon working with me said, "If there is anything you want to do on this case, I am perfectly willing to have you do it." I instituted the treatment that Dr. Price has given you today, giving this man calcium and phosphorus and an activator, and we exposed his entire body to ultraviolet light every day. Some day, I hope to report this case and show you a beautifully regenerated jaw. The fractures were reduced, and I might say that it will be interesting to Dr. Price to know that the jaw was so full of punctures with rubber drains that all our appliances were removed; that we had a marked displacement of the fractured segments due to the contortion of the muscles from the septic condition, and yet in a little over three months, we removed sequestrum, the regeneration of bone continued and the fractures were reduced without any wires or any appliances on at all. I have the hospital record to prove the statements that I am now making.

A. T. Rasmussen, La Crosse, Wis.: For the benefit of those who are inclined to consider this subject an academic one only, I wish to emphasize the fact that it is an exceedingly practical one. I am on record a number of times as saying that we must

think of certain periodontal diseases as calcium and phosphorus deficiency diseases. Having followed this line of thought and instituted treatment accordingly, I have been able to show clinical results that have been eminently worth while. The worst cases of periodontal diseases with which we have to deal are not those exhibiting a free flow of pus. I am not very much concerned about getting rid of pus! I do not seem to have much trouble with that; but those cases in which there is a progressive and persistent destruction of the alveolar processes, in spite of the fact that no local irritation or infection is apparent, are the ones that baffle most of us, I believe. It matters little what you call these diseases. They are deficiency diseases, and must be treated as such, if results are to be attained. In such cases, I have been able to show some clinical results that have pleased me immensely, and have confirmed my diagnosis of the case as one of calcium and phosphorus deficiency. Extreme susceptibility to dental caries has been changed to a relative immunity, or, should I say, a lessened susceptibility, under similar treatment. The study of mineral metabolism of the system is an exceedingly interesting one. I believe it holds the key to the solution of some of our problems that up to this time have baffled the scientific world.

DIAGNOSIS AND TREATMENT OF DISEASE OF THE MAXILLARY SINUS*

By G. B. TRIBLE, M.D., F.A.C.S., Washington, D. C.

IT IS refreshing to go over the literature on diagnosis and treatment of diseases of the maxillary sinus, for it is so different, and the writers are at such variance. It can be learned that not one case in a thousand is directly due to dental conditions and that nearly all are from that source.

For this reason, the opinions expressed here will be those from personal experience, based on a routine that embraces the following methods of diagnosis: first, the history is taken as regards the nasal state, sense of smell, frequency of colds, headache, or other pain, vasomotor rhinitis, hay-fever, laryngitis, asthma, bronchitis, the occurrence of disagreeable tastes or odors, eye complications and history of operations, if any; dental history relating to the upper bicuspids and molars, and occurrence of neuralgia. Next, the physical inspection is made, taking note of the anatomic relationships, occurrence of deflections of the septum or the presence of septal spurs, the appearance of the nasal mucosa, the condition of the turbinates, particularly a boggy, blue-gray appearance of the inferior turbinate, the presence of free pus or polypi, evidence of swelling around the gums or around the eyes and the condition of the teeth. The postnasal mirror is then used. The mucosa is shrunk by the use of weak cocain-ephedrin or ephedrin-butesin solution, the naso-pharyngoscope being again employed; then transillumination is used, including the teeth, and a search is made for oral fistulas from the teeth or tooth sockets to the antrum. Thereafter, roentgenograms are taken and the antrum is punctured under a local anesthetic, with a straight needle, the opera-

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tor entering beneath the inferior turbinate and aspirating to see that the antrum has been entered, and the needle point is free. If this be found, the antrum is then irrigated with a weak sterile salt solution, the contents are examined in a black receiving basin and saved for cytologic examination, and, after irrigation, air is blown through to dry out the cavity.

At this juncture, in indicated cases, lipiodol or some other roentgenopaque solution is employed. In cases presenting oral fistulas, exploration and washing of the cavity through the opening is made use of, and lipiodol, 50 per cent in liquid petrolatum, is injected without antrum puncture. Ordinarily, about 5 or 6 c.c. of lipiodol one-half and liquid petrolatum one-half, is used, and will fill up the free space in the antrum and run over through the ostium into the nose or down the throat. A small cotton pledget is then placed under the middle turbinate, and, in the case of oral fistulas, the outlet is also plugged, and the patient sent for another roentgenogram.

TABLE 1.—RESULT OF ROENTGEN-RAY EXAMINATION OF ONE THOUSAND CASES

Sinus Affected	No. of Cases	Per Cent
One maxillary sinus	330	33.0
One maxillary and one frontal sinus	253	25.3
One frontal sinus	163	16.3
Two maxillary sinuses and one frontal sinus	88	8.8
Two maxillary sinuses	75	7.5
Sphenoidal sinuses (usually in conjunction with other sinuses)	49	4.9
Two maxillary and two frontal sinuses	21	2.1
Pansinusitis	15	1.5
Two frontal sinuses	6	0.6
		100.0

The examination of swabs, after rubbing of the nasal mucosa and the postpharyngeal membrane, as well as the determination of the relative number of polymorphonuclears as compared with lymphocytes, has not been given the attention that it perhaps deserves, but in the future will have more time devoted to it. So far, it has appeared open to the danger of fallacy, from the superficial inflammations that are often found in the collections of lymphoid tissue, such as the tonsils, and isolated adenoid masses, which are always present, or from marginal gingival conditions.

The question of the localization of the infection to the antrum cannot be definitely settled, for there is a tendency for a sinusitis to become a polysinusitis or pansinusitis, no matter where originally situated. Some light can be had on this point from the work of Drea,[1] who found in a group of 694 roentgen-ray examinations of the frontal and ethmoid sinuses, and antrums, that 51.5 per cent presented evidence of disease, and in this pathologic group, 86.3 per cent showed antrum disease, and 154 patients, or 43 per cent, showed antrum disease alone; so that of the total number examined, about 25 per cent showed only antrum disease and, in this number, without opaque injections and merely with stere-

TABLE 2.—DISTRIBUTION OF ETHMOIDAL INFECTIONS

Location	Per Cent
Ethmoidal (one side)	17
Maxillary and ethmoidal (one side)	26
Frontal and ethmoidal (one side)	14
Frontal, maxillary and ethmoidal (one side)	29
Two maxillary and ethmoidal (one side)	3
Two maxillary and ethmoidal (two sides)	11

1. Drea, W. F.: Polypoid Tissue in Maxillary Antra, X-Ray Diagnosis, Am. J. Otol. Rhinol. Laryngol., 34:360 (June) 1927.

oscopic films, about 45 per cent of these antrums considered diseased showed evidence of polypoid tissue.

The findings of Bierman, working with our cases, in 1,000 roentgenograms of the frontal and maxillary, and in a few of the sphenoidal sinuses, of cases giving evidence of disease justifying roentgen-ray examination, are given in Table 1.

The findings in 300 cases examined for the distribution of ethmoidal infections are given in Table 2.

From this, it can be seen that our figures are in substantial agreement with others quoted, and probably represent a fairly good average of sinus cases in their various divisions, and if punctures are made and contrast injections of roentgen-opaque solution used, additional cases of filling defects from granulations or polypoid tissue would have been brought out, and the characteristic shape of cysts, no matter what their type, which are probably otherwise included in the cases showing opacity or thickened membrane, would have been outlined more clearly.

Recognizing, then, the presence of the large percentage of sinuses showing definite evidences of past or present infection, the large preponderance of antrum infections among these, and the large proportion in which the antrums alone are involved, it is time for the two professions, or rather surgeons with dental training as a foundation, and surgeons with medical training, to cooperate in this field of surgery of the upper jaw. The work of this paper will be confined to those points applicable to us both, and no attempt to express an opinion of your particular problems will be made, nor to worry you with the complicating factors introduced by the association of the other sinus groups. No more than passing note will be made of the vasomotor rhinitis, hay-fever, asthma group, which we believe, as Tobey does, to be a definite pathologic entity. Nor will you be bothered with a review of the anatomy or embryology of this field, with which you are as familiar as we are.

The particular points of contact, in which the work of each supplements the other, are: (1) infections of dental origin, due to invasion because of contiguity; (2) invasion from unavoidable trauma in extraction; (3) resultant fistulas; (4) antral cysts, new growths and malignancies, and, going back to the first and reversing the process, the injury to the vitality of the teeth, and the influence it has in determining the surgery needed, from the presence of infection of nasal origin in the floor of the antrum.

Qualls,[2] of Memphis, remarks, apropos of our present status in the diagnosis and treatment of maxillary sinusitis, "The wealth of teaching in textbooks is too often impersonal, and represents rather a legacy flowing from one's ancestor's than a fortune newly won by hard endeavor."

Skillern,[3] in "Diagnosis and Treatment of Chronic Antral Infection," after reviewing the anatomic variations which render it difficult to make a definite diagnosis in an obscure case, with vague symptomatology, tersely remarks that to arrive at an exact knowledge of the pathologic condition inside the maxillary antrums, use must be made of a standard procedure, and even then it depends upon (1) the astuteness of the specialist in treating sinus conditions to evolve the suspicion; (2) roentgen-ray

2. Qualls, H. W.: New Orleans M. & S. J. 78:667 (April) 1926.

3. Skillern, R. H.: Ann. Otol. Rhin. & Laryng. 37:1187 (Dec.) 1928.

plates to corroborate the suspicion; (3) the needle to prove the suspicion.

Note must be made of the character of the pus, whether granular or fetid, in dental infections, and sometimes in bone or deep mucous membrane involvement. Note must be made also as to whether changes take place in the character of the pus on repeated washings, and use may be made of the intra-antral administration of mild antiseptics, though their value is limited and about as good results may be had by using a weak solution of silver nitrate or alcohol, as with the newer dye products. The percentage, in Skillern's opinion, is about one case of dental origin in five. He is inclined to feel now that many cases presenting devitalized teeth were originally nasal, and later a secondary infection arose from the same devitalized teeth which had its onset in the fundamental nasal disease. The treatment he recommends, after the failure of irrigation by cannula, and proper dental attention, is, first, a small opening of the Krause-Mikulicz type, followed, if unsuccessful, by the Luc-Caldwell operation; but he does not approve of the Denker or other operations of similar nature, which tend to destroy the anatomic support of the upper jaw; quoting, in this connection, the classic case of a man who had a double Denker operation and who, on running under a clothes line or some such obstruction, was caught about the upper lip and the upper jaw and teeth were pulled completely loose.

THE PROBLEM OF COOPERATION

The uncertainty of both oral surgeons and rhinologists about the handling of these cases has prevented that cooperation which is so valuable. The tendency with us to neglect the rôle of dental infection, and the tendency with you to overlook the infections of the other sinuses, and their influences on the antrum, and in turn, the influence of the disease of nasal antrums on the teeth, have caused much loss of time and have made for poorer results than should have been had. It does not matter what percentage are of direct dental origin, or whether the infection were originally nasal and the vitality of the teeth has become injured, necessity for cooperation is not lessened. We have in addition the relationship to general medicine which arises from diseases in our joint field.

Chronic upper respiratory conditions, coughs and colds are more often amenable to relief from nasal surgery, if they arise from an involvement of the sinuses, than is the case with the vasomotor rhinitis, hay-fever, asthma group, which show only a small percentage of improvement from any surgical procedure in that field.

In antral infections of dental origin, the infective agent is often a facultative anaerobe, and the infection may be unnoticed until some dental procedure, such as extraction, arises, and then there is a lighting up of this infection, and the patient traces his condition to dental operations, when, as a matter of fact, it had been present for a long time and had only been called to his attention at that particular moment.

Some time ago, there was a report by a British exodontist who recommended a mere rocking of the infected tooth to determine the reaction and partially immunize the possessor against a systemic invasion which he feared might come from immediate extraction and opening of new spaces. It is not necessary for a direct break to occur in continuity of the tissues around the tooth root to get an infection in the antrum. Infection spreads by thrombophlebitis of the small veins or

by an extension of an osteomyelitic condition of the alveolar margins of the superior maxilla, or even from a periodontitis. The unavoidable trauma in manipulating a tooth in extraction, associated with lessened strength and resistance from the condition of the bone or from anatomic pecularity, will, in some cases, cause a break in the floor of the antrum, which may not be large enough to attract attention, but which will permit the entrance of infected matter from the tooth socket and the mouth bacteria, or which may be carried in if forcible syringing of the wound is practiced.

With a normal antrum and no destruction of the epithelium, there is but little reaction after such an extraction, and the wound can be cleansed and sutured with no ill effects. If a secondary infection of the antrum does appear in this connection, puncture and aspiration in the beginning will often clear up the infection by removing the infectious material from the antrum mucosa and preventing probable destruction of the ciliated epithelium, and it is rare that one of these infections does not clear up when taken care of promptly.

If drainage is still insufficient, it may be necessary to make a small nasal antral window. If, in spite of prompt treatment and suturing, the epithelium has invaginated into the mouth from the wound and there has been a fistula, closure is much more difficult than at the time of immediate operation. Slide flaps, as in the Mayo plan, are probably best, combined with freshening of the wound, clearing away of any projecting particles of bone and removal of the osteomyelitic area around the floor of the antrum. If granulation and polypoid degeneration of the membrane have developed, they will not always clear up by this method and a window will probably have to be made in the nasal antral wall, or even a Luc-Caldwell operation be performed.

The question of success or failure of antrum operations is a very pertinent one at this time when so much attention is being given to these conditions and so many of these cases are seen first by dental surgeons. There should be a frank understanding between the two professions as to just what can be expected and what can be safely recommended to the patient.

Antrum operations can be roughly divided into the purely intranasal, and the open type, such as the Luc-Caldwell or Denker, or one of the modifications. The subturbinal intranasal operation is much the simpler, and can be made a part of a later operation, and has many points of value. The open operation has the advantage of permitting a direct inspection of the cavity and is the only one in which it is anatomically possible to remove the diseased mucosa in cases where it should be done. The old Cowper operation can have no place in this scheme of things, for it has all the disadvantages of the intranasal, of not permitting inspection, and has the added disadvantage of making a fistulous communication with the mouth.

The causes of failure after the Luc-Caldwell operation, as given by Cline in "Diagnosis and Treatment of the Maxillary Sinus,"[4] may be summed up as follows: 1. Insufficient removal of diseased tissue, with failure to remove all the diseased areas. 2. Establishment of too small a communication with the nose. 3. When the cause is of dental origin, overlooking of necrotic bone in the alveolar process. 4. Subsequent reinfection from the nose.

There are other minor complications

4. Cline, B. M.: J. M. A. Georgia, 15:181 (May) 1926.

usually due to some error in technic or arising from anatomic anomalies, and among these we must consider the possibility of formation of a fistula, which will often arise if the resected area in the anterior surface is too large or if it has had dressing and packing removed through it; or if the incision, as made in the classic way, is too near the roots of the teeth. The incision should be made as high as possible. Recently, we have made use of a perpendicular incision. This is not so apt to be followed by a fistula. It has the disadvantage of compelling the operator to work through a smaller space, and if there is too much retraction of the soft tissue, or trauma to the periosteum, there will be edema and occasionally a phlegmon in the soft tissue. We have twice had this misfortune, and it has somewhat dampened our earlier enthusiasm about this incision.

We feel that this disadvantage can be overcome if proper retraction can be devised, and this makes a much neater operation and leaves no scars to impinge on a subsequently made dental plate. There is a distinct disadvantage in injury to the teeth from too deep resection of the anterior wall, and this trouble is of serious import. There is always a loss of sensation anyway, for a time, in that area, and if the wall is resected too amply, or the bone curetted too thoroughly, devitalization of the teeth may occur, not from a destruction of the nerve supply, but from interference with the vascular system, and a resultant swelling, and loss of nutrition.

In the intranasal operation, or in making the window in the Luc-Caldwell operation, care must be taken not to injure the nasal-lachrymal duct, or the turbinate, with resultant scars and adhesions. In cases not readily healing, it is wise to eliminate the question of syphilis.

Then there is the wet versus the dry after-treatment, the question as to when to irrigate and when not to do so. With us, irrigation has been a marked advantage in cases of dental origin, with foul-smelling fetid pus; while in cases of nasal origin, the tissues tend to get boggy, and healing is delayed if irrigation is practiced. The question of anesthesia, local or general, is one depending on the preference of the operator, and based upon the general condition as reported by the internist.

The question of antral cysts and new growths is one which concerns the two branches of surgical practice in this field, and really embraces the general surgeon as well. Cysts of the superior maxilla are resorption spaces in the alveolar process and are not inflammatory; while the follicular cysts are due to disturbances of dental development, and are not true intra-antral cysts, such as develop there from the mucous glands in the epithelium. The first two are usually seen by your branch of the profession and the last by ours.

On puncture, occasionally a free escape of cyst fluid will follow, and if a secondary infection occurs, there is simply a suppuration, which will need be healed as others. Lipiodol is an invaluable aid in differentiating these cases from a hyperplastic sinusitis.

Granulomas, entrance of fragments of tooth or whole roots, accidents with dental appliances are more often encountered by you, and only secondarily referred to us. If examination through the wound by direct inspection, or the use of the nasopharyngoscope through the wound, shows marked pathologic change of the lining membrane, the case is best treated by dentist and physician together.

MALIGNANCIES

In one respect, there is a unanimity of opinion and that is as to the gravity of malignant conditions. Gordon B. New,[5] in "Malignant Diseases of the Antrum of Highmore," reports on the extensive work at the Mayo Clinic, and the interesting feature is that there have been two forward steps, one following the other. The first was the replacing of operation by the use of the cautery and radium; the second, the replacing of the cautery by diathermy. The end-result in seventy cases of primary malignancy has been 30 per cent apparent recoveries after from a little more than one year up to eight years.

In twenty-seven cases of secondary malignancy, fourteen patients were alive after from a little more than one year up to eight years, but all of the growths were squamous cell epithelioma, grade two.

This serves to bring out the necessity for prompt recognition of these conditions, and it is to the oral surgeon that most of these cases go first.

The early presence of pain and discomfort under the cheek, due to irritation of the superior branch of the trigeminal nerve, or persistent toothache, unrelieved by treatment because the pain is in the alveolar process and does not subside with the extraction of apparently diseased teeth, causes the patient to go from dental surgeon to dental surgeon seeking relief. If the involvement is secondary to an ethmoid malignancy, there is more often pain around the eye, and there may be local swelling which is mistaken for infection of the tear sac. Nasal discharges may or may not be present. In secondary infections, on the basis of an old chronic infectious process in the sinuses, there is usually a constant discharge. A little later, there is the characteristic foul odor. We have had a case in which the odor was so bad that a special time had to be arranged for treatment. At this stage, there is frequently spontaneous bleeding which, in elderly patients, is often mistaken as indicative of high blood pressure. Glandular involvement is ordinarily of later appearance, and when it occurs, there is but little chance of even a recession of symptoms.

We have been unable, in the six cases of malignancies seen, to succeed in saving a single case. All were advanced when first coming under observation; all had undergone dental treatment except one, which was an edentulous case with a swelling at the corner of the eye, the malignancy developing in the ethmoidal plate first.

This is the age of cooperation. Probably the experience that most of you have had in the military service taught you the necessity of combining your work with that of others in the surgical field. There is room enough, work enough and glory enough for all, and the best interest of the patient demands that he be taken as an entirety and that we not view him as the seven blind men did the elephant in Aesop's fable, familiar to your childhood.

DISCUSSION

Theodor Blum, New York City: If I am not mistaken, Dr. Trible mentioned the fact that antrum infection can arise from a diseased condition of the gingiva. Whether this is so or not is difficult to decide. It may interest you to know that it was proved, many years ago, that infection from the tooth can enter the antrum even though the apex is not close to the soft tissue lining of the antrum. The infection can be carried through the bone into the antrum. Keeping this in mind, we can easily realize that an infection from a very deep pyorrhea pocket, assuming

5. New, G. B.: Arch. Otolaryng., 4:201 (Sept.) 1926.

there is a low antrum, could enter the antrum. The question as to the etiology of antrum disease is important. It seems to me that the infections due to teeth and maxilla comprise the smaller group. In all cases, we as oral surgeons should keep in mind that the antrum really belongs to the rhinologist, and we have no right, unless we practice the specialty of rhinology, to treat antrum disease unless the infection arises from some dental process. On the other hand, since we speak so much of cooperation, I feel that the oral surgeon is better prepared to take care of cysts in the region of the antrum than is the rhinologist. Mention was made of experimental work on dogs in which the whole antrum membrane was removed, and then regenerated. I would like to mention at this point, especially because there are so many radical operators—and I am not radical, believing that as much of the antrum membrane as possible should be left in position—that the analogy is not logical. In dogs, the antrum membrane which is removed is a normal antrum membrane, in a normal dog; whereas the antrum membrane we remove is diseased antrum membrane in diseased individuals. With regard to the antrums which are accidentally opened by the oral surgeon or dentist during operation, I wish to say that if they are cleaned and are left clean, they will not become infected. That many of those antrums do become infected is due to the fact that so many operators insert gauze or other means of packing into them.

PERIODONTOCLASIA: THE RELATION OF DISEASES OF THE PERIODONTIUM TO SYSTEMIC DISEASE*

THOMAS J. COOK, D.D.S., Rochester, Minn.

PERIODONTOCLASIA, a disease which destroys the investing structures of the teeth, is the result of a chronic inflammatory, and slowly progressive proliferative reaction. This disease is encouraged in an unclean mouth, where there is some mechanical injury, and it may be influenced by certain systemic diseases. When the bacteria of the mouth, which under normal conditions are harmless and of low virulence, gain access to the periodontal tissue, they set up a destructive inflammatory process which may be followed by suppuration. The absence of immediate symptoms does not indicate that progressive injury is not occurring, but only that the effects of bacterial injury have not become clinically visible. When the bacteria gain a foothold in the tissues, there is a reaction of infection. The infected tissue becomes infiltrated with various elements of the blood, especially the polymorphonuclear leukocytes, plasma cells and fibroblasts. (Fig. 1.) The disease progresses at the expense of the supporting alveolar process, and finally leaves a pocket about the affected tooth, filled with chronic inflammatory granulation tissue.

The active bacteria of this disease reside within the infected periodontal tissue. (Fig. 2.) They support themselves and produce toxins which, along with bacteria, are carried from this site or focus of infection by way of the blood and lymph stream, to various parts of the body, where it is believed they may cause

*From the Division of Experimental Bacteriology, the Mayo Foundation.

*Read before the American Academy of Periodontology, Washington, D. C., Oct. 3, 1929.

pathologic conditions. Streptococci, when isolated from a deep pocket or infected tissue of a patient troubled with periodontoclasia will, on injection into animals, reproduce in the tissues of the animals lesions resembling those from which the patient is suffering.

LITERATURE

Adair[1] stated: "It is far better to prevent pyorrhea than to wait for the disease to attack the mouth, for when it does make its attack, very frequently it leaves in its wake rheumatism, neuritis, infection of the eyes, heart trouble, kidney lesions and digestive disturbances."

Bloodgood[2] described rheumatism, joint conditions of all kinds, and chronic disease of the heart, arteries and kidneys, and stated that disease of any organ or tissue in the body may be the result of infection that had its origin in the mouth or sinuses.

White[3] made the following statement: "It is almost a daily observation that gastric and duodenal ulcers, appendicitis, and infection of the gallbladder lack a

ELECTIVE LOCALIZATION FOLLOWING INTRAVENOUS INJECTION IN RABBITS OF STREPTOCOCCI FROM REGIONS OF PERIODONTOCLASIA IN PATIENTS SUFFERING FROM VARIOUS DISEASES

					Animals in Which Lesions of Various Regions Developed, Per Cent						Incidence in Which Streptococci Were Recovered from Various Organs of Animals						
Systemic disease	Strains	Animals injected	Deaths	Mortality per cent	Joints	Eyes	Colon	Kidneys	Stomach, duodenum or both	Gallbladder	Blood	Kidneys	Liver	Gallbladder	Joints	Eyes	Mesenteric lymph nodes
Arthritis	10	40	8	20	35			5	8	3	30	5	3	5	35		
Iritis	10	40	6	15		45		3	5	5	45	3	5	3		30	
Colitis	20	80	45	56	8		33	3	8	3	35	5		8	8		20
Nephritis	10	40	20	50	5			25	5		25	20	5	3	3		
Ulcer of stomach or duodenum	11	44	20	45	2			5	36	5	32	7		2			
Cholecystitis	10	40	18	45				3	3	30	28	5	5	20			
Encephalitis	2	8	6	75							25						
Torticollis	2	8	5	63							25						
Total	75	300	128	43													
Control cases	25	100	36	36	7			6	8	4	29	18	21	14	12		

1. Adair, Robin: What the Patient Should Know about Pyorrhea Treatment, J. A. D. A., 16:182-184 (Jan.) 1929.

2. Bloodgood, J. C.: Diseases of Mouth; Domain of Stomatology, J. & Rec., 123:669-671 (May 19) 1926.

3. White, C. S.: Focal Infection in Relation to Abdominal Surgery, with Special Reference to Ulcers of the Stomach and Duodenum, Appendicitis and Cholecystitis, J. A. D. A., 10:496-499 (June) 1923.

causative agent in the nature of infectious disease and traumatism, but, in their stead, we see frequently a mouth that fairly reeks with pyorrhea. The wonder is that so many escape serious surgical disease with such infections of the mouth."

Goadby[4] found a definite relationship between diseases of the gums and arthritis. He was able to produce experimental rheumatism in a rabbit by means of streptococci isolated from pyorrheal pockets, and he secured recovery in some of the severe cases by eliminating the primary foci.

Benedict[5] advised the removal of all dental foci in the treatment of ocular disorders, and expressed the belief that there should be a satisfactory system of prophylaxis.

With Stafne,[6] I reported the isolation of streptococci from deep pyorrheal pockets of patients suffering from various diseases. When strains of streptococci isolated from patients with arthritis, iritis, colitis, nephritis, ulcer of the stomach or duodenum and cholecystitis were injected intravenously into animals, the results gave evidence that the streptococci had the power of elective localization.

Hartzell[7] stated his belief that "pyorrhea is caused by pyogenic cocci and but for them it could not exist, and that the predisposing causes of pyorrhea are identical with the predisposing causes of infection by any of the infective microorganisms."

The following appeared in the *Medical Journal and Record*[8]: "It is of first importance to keep the mouth and adjoining parts as clean as possible." Chronic rheumatism is the cause of more invalids and disability than any disease, and according to statistics gathered by the English Ministry of Health, 75 per cent of the causes of rheumatism in that country are due to infection of the mouth, largely an infection of the gums by a microbe of low vitality but of great persistence, probably a streptococcus. Taking all of these points into consideration, it may be stated without exaggeration, oral sepsis is an influential factor in production of disease."

Fisher[9] found, in thirty cases studied culturally, that the predominating organism on blood-agar plates was the green-producing streptococcus. He further stated: "The constant association of *Streptococcus viridans* in larger and predominating numbers with pyorrhea, as shown by cultural methods, its absence in the majority of normal gums cultured and the occurrence in sections of pyorrhea tissue of a gram-positive coccus, morphologically a streptococcus, in the deeper periodontal tissues, may be taken as evidence in favor of this organism being of much importance in pyorrhea."

METHODS OF OBTAINING MATERIAL FOR CULTURE

Material for culture can be obtained from about the teeth as follows: The mouth is freed of any food débris. The

4. Goadby, K. W.: Association of Disease of Mouth with Rheumatoid Arthritis and Certain Other Forms of Rheumatism, Lancet, 1:639-649, 1911.

5. Benedict, W. L.: Value of Dental Examination in Ocular Disease. Am. J. Ophth., 3:899 (Dec.) 1920.

6. Cook, T. J., and Stafne, E. C.: Bacteriologic Study of Pyorrhea Alveolaris, Dent. Cosmos, 71:115-120 (Feb.) 1929.

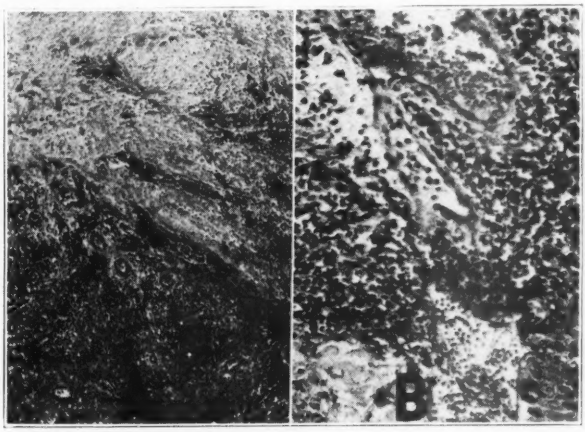
7. Hartzell, T. B.: Predisposing Causes of Pyorrhea Alveolaris, J. A. D. A., 13:621-623 (April) 1929.

8. Importance of Focal Infection, Editorial, M. J. & Rec., 123:394-395, 1926.

9. Fisher, J. H.: Pyorrhea Alveolaris: Rôle of Certain Micro-Organisms Found in the Lesions, Am. J. Pathol., 3:169-178 (March) 1927.

site from which the culture is to be obtained is dried and walled off with sterile gauze. It is then swabbed with iodin, which is washed off with alcohol, and the area is dried with a sterile swab. A sterile platinum loop is then inserted under the gum cuff and into the deepest part of the pocket. Immediately on withdrawal, the contents of the loop is used to inoculate two tubes of glucose-brain broth, one tube of brain-agar and a blood-agar plate.

Another method of obtaining cultures is as follows: A piece of tissue is removed surgically from around an infected tooth. Usually, these sections include tissue from one side and the bottom lining of a diseased pocket. The tissue is carefully washed in sterile solution of sodium chlorid, a portion is taken for microscopic study and the remainder is placed in a sterile mortar containing 3 c.c. of gelatin-Locke solution and sand. This tissue is crushed, and the material is used to inoculate two tubes of brain broth, one of brain-agar and a blood-agar plate. The cultures are made in these mediums because their nutritive and other qualities are especially favorable for the growth of organisms encountered in infections about the teeth. The mediums used in making three of the cultures contains brain substance. The brain substance renders the bottom of the medium practically oxygen free, and the top is saturated with oxygen; so that every degree of oxygen tension is provided between these two levels. Cultures in glucose-brain broth are suitable for intravenous injection into rabbits, and those in glucose-brain-agar are used especially to show the relative number of different bacteria in the inoculum and the approximate degree of infection in the focus. All of the cultures were incu-



A B

Fig. 1.—Section of tissue from a deep pocket, stained with hematoxylin and eosin. *A*, marked inflammatory reaction within the infected tissue; *B*, marked cellular infiltration, around a blood vessel.

bated for eighteen hours and examined with Gram's stain.

A mixed culture, with the green-producing streptococcus predominating, was usually found in all of the cultures studied. The streptococci were recovered in pure culture from the agar plates, were grown in glucose-brain broth and were used for inoculation of animals. Normal rabbits, weighing on an average 2,000 gm., were used throughout the study. Each animal received as a routine a dose of 5 c.c. at one time. The animals were killed at varying times, depending on the source of the strain of streptococci. Rabbits that received injections of streptococci isolated from patients with iritis were killed within seventy-two hours after the initial injection; whereas, those that received injections of streptococci from patients who had arthritis were killed three or four weeks after the initial injection. At necropsy, every organ was examined and the data were recorded. Cultures were taken from the various organs.

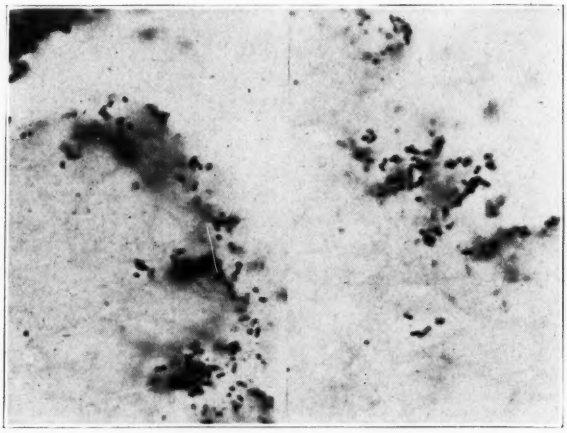


Fig. 2.—Bacteria within the infected tissue shown in Figure 1 (Gram-Weigert stain; ×1,000).

REPORT OF CASES

The following report is illustrative of a case of chronic infectious arthritis:

Case 1.—A woman, aged 40, came to the Mayo Clinic suffering with pain in both knees and in the right elbow, and generalized muscular soreness. A diagnosis was made of chronic infectious arthritis. The patient had had several pulpless teeth removed a short time previous to her arrival at the clinic, and thereafter she had experienced a feeling of slight discomfort, which had been followed by some relief of the arthritis. Roentgenographic examination revealed a deep pocket about the mesial surface of the lower right second molar tooth. This tooth had a large gold crown which had poor gingival adaptation and thus served as a source of irritation. The gingival tissue appeared inflamed and bled easily. This tooth was extracted and a section of tissue lining the pocket was removed, washed in solution of sodium chlorid, crushed, and cultured. A pure culture of streptococci was isolated, and four rabbits were given intravenous injections with the material obtained from culture. Lesions of the joints resembling those of arthritis developed in two of the rabbits. One of the two had lesions in the muscles of the right leg resembling those of myositis. (Fig. 3.) One

rabbit died of pneumonia, and in the other, lesions did not appear.

Cultures were obtained, either from deep pyorrheal pockets or from periodontal tissue of ten patients who had chronic infectious arthritis, and forty rabbits were injected with the ten strains. Thirty-five per cent of the rabbits became affected with lesions of the joints resembling those of arthritis. In a number of instances, typical symptoms developed, and usually the rabbit favored the affected leg. At necropsy, the involved joints were usually swollen and contained a turbid fluid which flowed freely when the joint was cut open. Culture of this turbid fluid from 35 per cent of the rabbits yielded streptococci; whereas, in 30 per cent of the rabbits, streptococci were recovered from the heart's blood.

Fig. 3.—Swollen joint of a rabbit that received an intravenous injection of 5 c.c. of a suspension of streptococci isolated from a deep pocket. The turbid fluid that was expressed from the joint is seen. Arrow points to a region of hemorrhagic myositis.

The following report is illustrative of the results obtained when cultures were made from about the teeth of patients who had diseases of the eye:

Case 2.—A man, aged 36, came to the Mayo Clinic, Oct. 15, 1928, complaining of pain in the right eye and of having had an attack of iritis, three weeks previously, which had responded to treatment but which had returned two weeks later. Examination of the eye revealed lacrimation of the right eye, congestion of the conjunctiva and definite injection. Search for foci revealed that the tonsils had been removed in 1922. The prostate gland was negative to examination, but periodontoclasia graded 3 was revealed by clinical and roentgenographic examination. There were deep pockets throughout the mouth, which offered a large area for the absorption of bacteria and their toxins. A culture was taken from a deep pocket on the mesial surface of the upper left second molar and another from between the upper right central and lateral incisors. Streptococci were isolated in pure culture from these deep pockets, and four rabbits were given intravenous injections. (Fig. 4.) In one rabbit, marked injection of both eyes developed after five hours. The animal was killed, and the organism was recovered from the eye. The third rabbit had marked injection at seven hours, but twenty-four hours later the inflammation was only slight. At this time, the animal was given another injection. Forty-eight hours later, it had a severe injection of both eyes. The animal was killed, and the streptococci were recovered in pure culture from the

eyes. Lesions did not develop in the fourth rabbit.

Forty rabbits were given injections of streptococci obtained from ten patients who had iritis, and lesions of the eyes, resembling those of iritis, developed in 45 per cent of the animals. Usually, this condition was demonstrable from four to eight hours after the animal had been given the injections with the material cultured. The number of lesions elsewhere in the animals was small. Cultures obtained from the blood and from the eye yielded streptococci in 45 per cent of the animals, at necropsy.

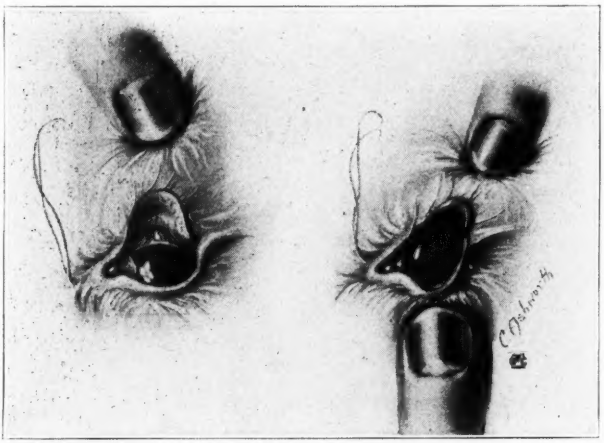


Fig. 4.—Marked inflammation of both eyes following the intravenous injection of 5 c.c. of a suspension of streptococci from a patient who had iritis.

The following case history is illustrative of the results obtained with cultures made from material from about the teeth of patients with chronic ulcerative colitis:

Case 3.—A woman, aged 26, who came to the Mayo Clinic, July 24, 1928, stated that she was having about ten stools daily, and that she had lost considerable weight. The history of this condition dated back to August, 1927, and had been of rather sudden onset. Abdominal pains were associated with many bloody stools, and a temperature of 104 F. had developed. She had been in bed from October to December, 1927, and had had from six to eleven stools a day. Hemoglobin was estimated at 53 per cent; erythrocytes numbered 4,220,000 and leukocytes, 9,700 for each cubic millimeter. The tonsils had been removed two years previously. Dental examination revealed periodontoclasia, graded 2, with diseased pockets about the distal surfaces of the upper left bicuspid tooth, the distal surfaces of the upper left first and second molars, the distal surface of the lower left second bicuspid, the mesial and distal surfaces of the lower left central incisor and the mesial surface of the lower left second molar tooth. The upper left first bicuspid and the lower right second molar were pulpless. August 14, the pulpless teeth were removed and tissue was removed for culture and study. Cultures taken from deep pockets, as well as those obtained from tissues, yielded a pure culture of diplostreptococci. The following day, the patient had an exacerbation of the symptoms, due to a mechanical disturbance of the focus, and was confined to bed with a temperature of 101 F.

Four rabbits were given injections of the cultures and one died of *Bacillus bronchisepticus* infection; whereas, in the three others,

hemorrhagic infiltration of the colon developed (Fig. 5) and soft stools were passed.

Cultures from about the teeth were obtained from twenty patients who had chronic ulcerative colitis, most of whom were hospitalized during the active stage of the disease. A large number of them gave evidence of neglect of the toilet of the mouth. Eighty rabbits were given injections with the twenty cultures, and, in 33 per cent, lesions developed in the colon, usually a hemorrhagic infiltration of the lower portion of the colon, accompanied by watery stools. The animals usually appeared sick and weak at the time that they were killed. Blood cultures yielded diplostreptococci in 35 per cent of the animals. In 8 per cent, lesions of the joints developed.

Fig. 5.—Hemorrhagic lesions in the colon of a rabbit that received intravenous injection of a culture taken from a diseased pocket in a case of chronic ulcerative colitis.

The following report is illustrative of the results obtained with cultures made from material from about the teeth of patients with gastric ulcer:

Case 4.—A man, aged 34, came to the Mayo Clinic in January, 1928, with a history of having had pain in his stomach for the last year, coming on about four hours after meals. He had been relieved by taking milk or soda. Ingestion of solid food resulted in sharp pains and vomiting after about two hours. The patient usually awakened at 12 or 1 o'clock at night with pain, and it was necessary for him again to take milk or soda. Search for foci of infection revealed one small tonsillar tag, several pulpless teeth and periodontoclasia graded 3. He had not taken any care of the mouth, and the oral tissues appeared inflamed on clinical inspection. All of the lower teeth were removed and material was collected from several pockets for culture. Green-producing steptococci were the predominating organisms isolated, and these were injected into four rabbits in pure culture. In one of the rabbits, marked erosion of the gastric wall resembling that of a peptic ulcer developed. (Fig. 6.) In another, hemorrhages developed in the stomach and duodenum. The other two did not display any abnormality.

Altogether, forty-four rabbits were given injections with cultures from eleven patients who had ulcer of the stomach or duodenum, and in 36 per cent of the rabbits, lesions developed in the stomach or duodenum; whereas, the percentage of lesions elsewhere in the animals was small. Blood cultures from the animals yielded streptococci in 32 per cent.

Material was obtained from about the teeth of ten patients who had nephritis, and forty rabbits were given injections of cultures made from this material. In 25 per cent of these animals, lesions developed in the kidneys. The number of lesions elsewhere was small. Twenty-five per cent of the blood cultures yielded streptococci.

Forty rabbits were given injections with cultures obtained from deep pyorrheal pockets of ten patients who had disease of the gallbladder, and in 30 per cent of the rabbits, lesions of the gallbladder developed. Twenty-eight per

cent of the animals gave positive blood cultures.

Three hundred normal rabbits were given injections of cultures made from material obtained with a platinum loop from observed pockets and from infected investing tissues about teeth affected by periodontoclasia. The patients from whom the material was obtained were suffering from various diseases, as shown in the accompanying table. Forty-three per cent of the animals died. The others were killed at varying intervals. The animals were divided into groups. All members of each group received injections of cultures of material from the same source. In some groups, the mortality rate was high; in others, low. There is no explanation of this other than that the virulence of the cultures injected varied. No animal received more than 5 c.c. at one injection. Streptococci were recovered from the blood of these animals in varying percentages. This variability may be explained as being due to the time interval between injection and death. Among animals that received injections of organisms derived from patients with iritis and colitis, the incidence of recovery of streptococci from the blood was higher than among animals that received injections of strains from patients with arthritis, because the animals receiving the strains from patients with arthritis were not killed until three or four weeks after injection; whereas, those which received strains from patients with colitis and iritis were killed within seventy-two hours.

Fig. 6.—Ulceration of the wall of the stomach of a rabbit after intravenous injection of streptococci obtained from a diseased pocket in a case of gastric ulcer.

CONTROLS

One hundred rabbits were injected with cultures of material taken from twenty-five patients who had periodontoclasia but who were not suffering from

any of the diseases that affected the patients from whom material was obtained for the experiments reported earlier in this paper. These cultures were studied with the same care and accuracy as the other cultures in the series. The mortality rate of the animals was 36 per cent and the remainder were dispatched with ether at different intervals. In this series, 7 per cent demonstrated lesions of the joints and muscles; 6 per cent, lesions of the kidneys; 8 per cent, lesions of the stomach, and 4 per cent, lesions of the gallbladder. Cultures were taken as a routine, and in 29 per cent of the series, streptococci were isolated from the heart's blood.

Despite the ill effects noted in these experiments, an encouraging feature is that periodontoclasia is definitely a preventable disease, and in the great majority of cases in which patients are not hopelessly affected, it can be arrested, the lesion healed and the disease permanently controlled by the removal of the existing infection and elimination of the predisposing cause, with the aid of the patient in the daily toilet of the mouth.

SUMMARY AND CONCLUSIONS

1. Streptococci isolated from deep pockets and infected investing tissues of the mouths of patients who had periodontoclasia, and who were suffering from iritis, arthritis, etc., on intravenous injection into rabbits will reproduce the disease in the animals.

2. It is extremely important that periodontoclasia be eliminated from the mouths of patients suffering from a disease on which a focus of infection might have some bearing.

3. Although streptococci isolated from regions of periodontoclasia practically always are associated with other bacteria, these other bacteria display but little power to produce metastatic infections. They are therefore not considered in this paper.

CONDITIONS THREATENING NORMAL OCCLUSION DURING THE PERIOD OF SHEDDING OF THE TEETH

By A. MARTIN SCHWARZ, M.D., Vienna, Austria

AS is well known, there takes place in children between the ages of 3 and 6 a slight but important change in the occlusion of the teeth, i.e., the lower arch undergoes a forward movement in relation to the upper arch. This process is the result of the normal chewing mechanism. With the exception of the temporal muscle, all of the muscles of mastication pull in an upward and forward direction. In consequence, the lower arch is drawn forward with each masticatory movement, and is brought into close contact with the upper arch by means of this pressure.

As a result of this procedure, the teeth become ground down in such a way that the lower set of teeth must move farther and farther forward. (Fig. 1.) This abrasion and forward movement (in a

mesial direction) are interdependent. Without abrasion, this physiologic forward movement cannot take place. In a set of teeth which shows considerable forward movement, the deciduous molars are ground down just as much as all the other deciduous teeth. If we try to reconstruct the cusps of the abraded deciduous molars in their relations to each other, we get as a result a cusp-to-cusp bite of the deciduous molars in the direction of Class III (Angle). (Fig. 2.)

Behind deciduous teeth which have shifted in this way, the first permanent molars erupt into normal occlusion. If the deciduous teeth of a 6-year-old child are not worn down, they have the appearance of those of a 2-year-old child. Their distal surfaces terminate in the same vertical plane. If this change of relationship has not taken place, the permanent

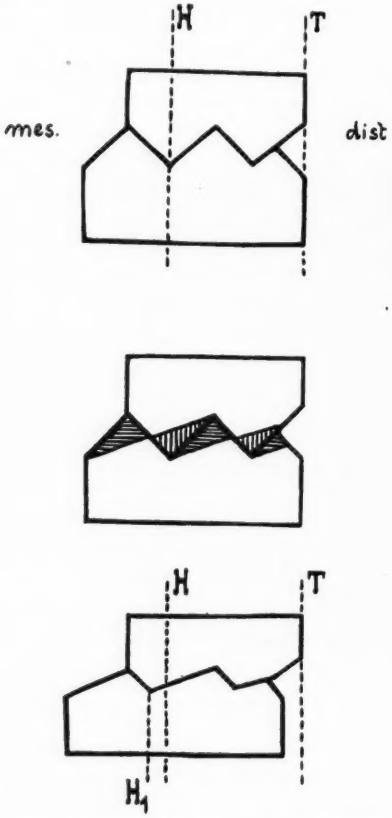


Fig. 1.—Interdependent abrasion and mesial shifting. Above: Normal occlusion of an upper and a lower molar. *T*, distal edges at the same level; *H*, line of occlusion. Center: The same molars ground down. The shaded areas shown the amount of abrasion. Below: Abraded teeth in occlusion. The lower molar has shifted mesially for the distance H-H_1.

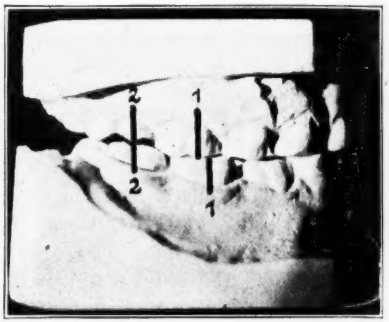


Fig. 2.—Abraded teeth of a child, aged 6 years; right side. The lines to the right (*1-1*) show a cusp-to-cusp bite, in the direction of Class III. Those to the left (*2-2*) show a cusp fissure bite.

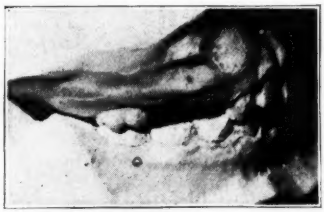


Fig. 3.—Teeth of a 10-year-old child showing cusp-to-cusp bite of the first permanent molars. The upper molar can shift forward without hindrance into a Class II position.

molars cannot be certain of normal occlusion, and erupt with a tendency toward a Class II (Angle) position.

This uncertain position usually persists for some years, i.e., until the deciduous molars are shed. As is well known, the upper deciduous molars are often lost sooner than the lower ones. The bicuspids being narrower than the deciduous molars, the first permanent molars shift about 2 mm. forward as soon as the second deciduous molars are lost. If the upper first permanent molar which is in this uncertain occlusion (cusp-to-cusp) now moves farther forward (mesially) while the lower one is retained in its place by the second deciduous molars, the result is bound to be a definite Class II (Angle) position of the permanent molars. The lower permanent molar cannot move from this unnatural position even when the lower second deciduous molars are lost. In a case like this, as the lower permanent molar is not able to move forward, the space in front of it is closed by the anterior teeth drifting backward, and the case becomes a full Class II (Angle) of this type. In this way, a set of deciduous teeth in normal occlusion but not ground down are succeeded by permanent teeth in a Class II position. If this takes place on one side only, the result comes under a subdivision of Class II.

In this sense, this particular order of shedding of the deciduous molars is a source of danger; therefore, the disadvantageous natural arrangement must be corrected. It is easy to avoid the bad result of such a state of affairs if one makes it a rule to extract the lower second deciduous molars as soon as the upper ones are lost. It is a great mistake not to extract in every case if the permanent molars are in an uncertain position. (Fig. 3.) (It is necessary to have a roentgenogram

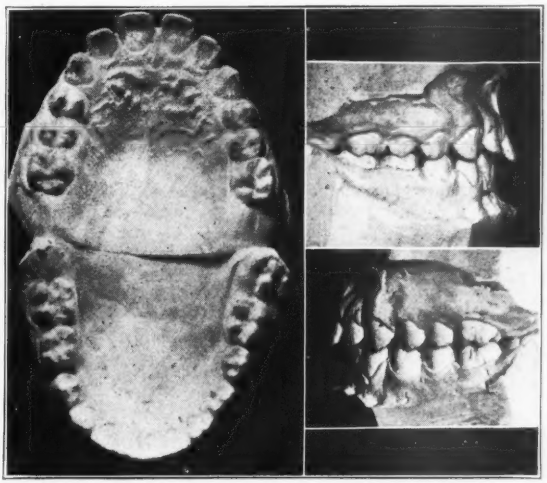


Fig. 4.—Teeth of an 11-year-old child. The only deciduous tooth in the jaw is the right lower second molar. This side shows a Class II bite. Left: Occlusal view. Right: Right side (above); left side (below).

taken beforehand to ascertain whether the lower second bicuspid is missing or not.)

Figure 4 shows a case of Class II (subdivision) on the right. On this side, the lower second deciduous molar stands firmly in the jaw, while all the others are already replaced by bicuspids. The first permanent molars here stand "cusp-to-cusp" (right, below) as before, but there

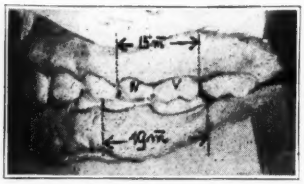


Fig. 5.—Teeth of a 9-year-old child. No mesial shifting of the lower denture is to be noted. There is a great difference in size between the upper and lower deciduous molars (upper, 15 mm. wide; lower, 19 mm. wide). The lower second deciduous molar extends distally so that the first permanent molars must erupt in Class II occlusion.

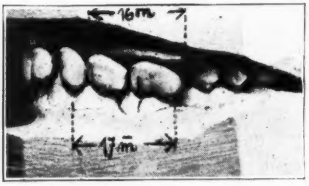


Fig. 6.—Teeth of an 8-year-old child. There is no mesial shifting of the lower teeth. There is little difference in the size of the lower and of the upper deciduous molars (upper, 16 mm.; lower, 17 mm.). The upper second deciduous molar extends distally. Therefore, the first permanent molars will erupt in normal occlusion.

are still gaps which will be filled by the forward shifting, so that on this side normal occlusion will result. On the right side (right, above), a similar result is made impossible by the unnatural relationship of the first permanent molars, due to the presence of the lower deciduous molar. If the unnatural relationship of the first permanent molars did not become established before the loss of the lower deciduous tooth, normal occlusion might still take place.

Another question is: Do the second maxillary and mandibular deciduous molars always terminate distally in the same vertical plane if no forward movement of the lower arch has taken place? Figure 5 shows the teeth of a 7-year-old child with the deciduous molars definitely in neutroclusion.[1] No wearing down of the cusps has taken place, and no forward movement. The lower second deciduous

Fig. 7.—Denture shown in Figure 5, one year after the extraction of the lower second deciduous molars. There is normal occlusion of the first permanent molars.

molar extends distally beyond the upper in spite of the condition of neutroclusion. Figure 6 shows the teeth of a 6-year-old child. The same definite occlusion of the deciduous molars in the normal mesiodistal relationship is present, with no wear of the cusps and no mesial movement. In both cases, there is a "close bite" (with incisor overbite); a typical symptom at the time of the loss of the deciduous teeth in cases in which the lat-

1. Neutroclusion is normal occlusion anteroposteriorly; distoclusion, Class II (Angle); mesioclusion, Class III (Angle).

ter have not been worn down. In Figure 4, the upper second deciduous molar extends so far distally beyond the lower that even now there is a definite neutroclusion of the first permanent molars. There is no caries at the contact points in either case.

The explanation for the various reactions of the deciduous molars is to be found in the different mesiodistal diameters of these teeth. In Figure 5, the upper first and second deciduous molars are 15.5 mm., the lower, 19.5 mm., the difference being 4 mm. In Figure 6, the upper first and second deciduous molars measure 16.5 mm., the lower, 17.5 mm.; the difference being 1 mm.

On an average, the upper bicuspids measure 13.5 mm., the lower, 14 mm. After the shedding of the deciduous molars (Fig. 6), the upper and lower first permanent molars shift forward about the same distance, i.e., from 2.5 to 3 mm. (somewhat less, since about 0.5 mm. is needed for the permanent cuspids; but as this is the same for both upper and lower jaws, no difference results). Of course, in this case, the first permanent molars remain in neutroclusion. In Figure 5, on the contrary, the upper first permanent molars must shift forward only about 2 mm., while the lower has to shift 5 mm. in order that neutroclusion may result. The lower molar cannot do this, because the definite interlocking of the cusps occurs before there is time for the necessary movement; which results in the Class II position.

In this case, a Class II condition can be avoided if, about one year before the shedding of the upper deciduous molars, the lower second deciduous molars are extracted, so that the lower first permanent molars can move forward. Figure 7 shows the same case as Figure 5, about one year after such an extraction. If the molar has shifted forward far enough before the bicuspids appear, the gap should be kept open mechanically. If a Class II position has already developed, a cap should be placed on the upper molars with a plane surface for the lower tooth to bite on, or a heightened central filling should be placed in the lower molars; or by means of an upper plate, the bite on the lower incisors should be raised.

Two different cases have been described here in which, with a normal set of deciduous teeth, a Class II relationship of the permanent teeth can result. The sequence of dentition, as well as the size of the teeth, is an hereditary factor; therefore, the Class II type can, in such cases, be hereditary. Still, we cannot maintain that here the Class II condition itself is hereditary. This is not quite correct: the Class II condition is only the necessary mechanical consequence of these hereditary anatomic and ontogenetic factors.

The problem of the heredity of bite anomalies can find its explanation in some cases in simple mechanical processes.

THIS THING CALLED DENTAL ECONOMICS

By HAROLD J. NOYES, B.S., D.D.S., Chicago, Ill.

THE dental profession has decided to take the skeleton of dental economics from the closet. The emphasis which falls on this subject as it approaches professional consciousness might lead one to think it new and unique, but if we consider more carefully, it becomes evident that the basic problems date from the first man who received compensation for rendering a dental service. As long as men and women have been able to obtain a more or less adequate income by the practice of dentistry, it has been of concern to them individually.

The unique aspect of the present interest lies not so much in the economics of the individual dentist as in the economics of dentists collectively. This recognition of the subject as a matter for the consideration of the profession as a whole through its rather complicated mechanism of professional societies and organizations is a step along a hazardous path, and unless the journey is directed by men of honesty and integrity (of which there are few either in or out of the dental profession), there is grave danger of serious complications.

In this age when all phases of our life are open to critical analysis, there is no reason for excluding a scientific study of the economic aspect of dental practice. This same type of scrutiny into the mechanical and biologic problems of dentistry has resulted in the growth in dental knowledge of the past fifty years and, of more importance, the tremendous improvement in rendering dental service to the public. There is no reason to believe that a similar mutual benefit may not arise from the application of the same type of study to the economic side of dental practice. It must be comprehensive, thorough and honest and not another crime committed in the name of science. Neither the profession nor the public can or will benefit permanently at the expense of the other.

The opposition to a collective attack on the problem or its recognition by dental societies has, until very recently, been successfully maintained by leaders within the dental profession, falling roughly into two classifications. One is comprised principally of men who conscientiously feel that any recognition of this phase of dental practice would only serve to emphasize the growing commercialism within the profession. Their attitude is one of apprehension. For every one who has maintained his ideal in spite of his school training or caught a spark from which to light it while an undergraduate, they see a score of young men ground out of our dental school mills with no more scientific approach to their problems than the graduate from the schools of mechanical dentistry.

Nor is their apprehension without grounds. The realism of the picture becomes clearer if we compare the present condition with that of fifty years ago. At that time, dentistry was not a particularly alluring field. The surface of

its scientific problems had hardly been scratched. The public had just begun to be aware of the relation of oral conditions to general health and were, consequently, unwilling to pay more than very moderate fees or to seek the aid of the dentist except in extensive loss of function or severe pain. Preventive measures had scarcely dawned on the consciousness of the general public; and the social position of the dentist was not enviable.

As a consequence, men entered the field for neither monetary reward nor social prestige, but rather because they saw an opportunity to relieve suffering and to advance human knowledge in a direction which had been sadly neglected. The leaders of this time worked devotedly, many with little or no previous training. The fruit of their labors is gloriously shown by the present position of the profession. Few of these men became wealthy through their practice. They paved the way for higher fees and multiplied the number of operations by demonstrating the need for dental services and the value of such service, not only through greater comfort to the individual but also by increasing his efficiency. It then became profitable to perform dental operations. And with the advance in economic status of the dentist and progress in scientific training, there came a heightened social position. At this point, dentistry began to attract men ambitious of attaining both these ends and not particularly concerned with either the advancement of knowledge or the relief of suffering.

It is at this time that we find our dental schools flooded with a very undesirable type of student: one who would tolerate all the scientific training designed to better fit him to serve his patients in order that he might, on graduation, enjoy greater economic and social prominence. These men are much interested in dental economics. It is for this reason, I say, there is ground for apprehension. Men who have labored honestly and earnestly to build the present structure of dentistry are reluctant to add another wing which they feel will do much to legitimatize an attitude with which they are not in sympathy.

There are others falling in the second group, more subtle and less honest in their position, who oppose the recognition of dental economics either openly or adroitly. They have realized that there was greater return in cloaking their ambition for professional, social and economic prestige in the vestments of science and ethics. As long as dental societies confine their attention to matters concerned with the mechanical, biologic and chemical aspects of the profession, it remains bad form to scrutinize too carefully the economic practices of its members.

Thus, it becomes possible, through participation in the activities of dental societies, to gain professional eminence without reference to economic practices which may be of questionable benefit to the profession as a whole and to the public. These men are loud in their clamor over dental ethics as long as dental ethics remains the intangible phantom which it now is, and they are even more emphatic in their cries against dental economics which, as they see it, may throw too analytic a searchlight on the conduct of the business side of dental practice.

It must be remembered that the foregoing is not an attempt to classify the entire profession with regard to its stand on the matter of dental economics, but only to point out two attitudes which have appeared to stand out sufficiently to merit consideration. We might similarly classify those on the affirmative side of this question roughly into the following

groups: (1) those who hope to justify their materialistic attitude by turning the profession economic-minded; (2) those anxious to obtain some light on a side of their practice which, because of their attention and interest in the purely professional side of their vocation, has been sadly neglected, and (3) those who would like to have it studied in a scientific frame of mind and stripped of the glamour of a "get rich quick" method, yet clarified and made available as a means of eliminating waste and inefficiency in rendering dental service to a public which needs it.

Although I appreciate the point of view of the men who oppose dental economics because of honest fear for the profession, I do not agree with them. I cannot but feel that the best way to cope with the problem is to throw light and plenty of light on the matter. Attack it in the same manner that we would go about the study of any other problem associated with the practice of dentistry. The second group of the opposition has more accurately analyzed the situation, and their reasons for opposing it are some of the greatest points in its favor; namely, that it would, through impartial analysis and study, disclose conditions and practices of many so-called ethical practitioners that are not to the economic interests of either the profession as a whole or the public.

But to consider opposition at all is, perhaps, beside the point, for one has but to review programs of dental societies which have met within the past few months to realize the extent to which attention is being given this matter. The time is not far distant, if indeed it has not already arrived, when the profession will have to face the issue. Will we run it as another dental fad and ruin its benefits by cultivating its evils?

There is some danger of dividing the profession into economic societies and scientific societies. A similar condition prevails in medicine at present. There are medical societies in some of our larger cities which developed principally because economic and political twaddle consumed a major part of the time and absorbed the attention of the larger organization. It is possible to develop dental economics in a spirit of honest research which is wholly compatible with the highest ideals of a professional society. But it will be much easier to allow this subject to further demoralize the existing dental societies and, in this manner, lead to the two-society condition which obtains to some extent at least in Europe.

This is unfortunate, for it places too great emphasis on its importance in the economic societies and falls short of impartial analysis, which is essential to a scientific attack. As long as men practicing dentistry receive remuneration for their service, and as long as the public pays for such service dental economics is a problem of the profession. It is not the whole or major factor in the profession as long as dentistry remains a profession; it may become so if dentistry chooses to become a trade. We may study the application of economic principles to the practice of dentistry through our existing dental societies with mutual benefit to the profession and to the public if we preserve an honest, scientific and altruistic attitude. And by doing so, we may prevent the tail from wagging the dog.

We are approaching the time when this thing called dental economics will be squarely before the dental profession. Whether we make it a factor in the advancement of dental science and public welfare or allow it to become a malicious force with morbid influence is a challenge to our integrity.

DEVELOPING DENTAL ANATOMY INTO A BASIC DENTAL SUBJECT*

By W. P. HARRISON, D.D.S., Los Angeles, Calif.

THE subject of dental anatomy, from a teaching standpoint, is classed as perhaps the foremost requisite of the dental curriculum. It has therefore been placed in the freshman year as one of the primary subjects, varying in its status of importance according to the time alloted and to the method of teaching. The course generally has consisted of descriptive anatomy as formulated by G. V. Black and others, and a variable laboratory technic consisting of enlarged carvings of plaster, soap and wax or normal size bone carvings and drawings. Tooth morphology is generally included, with a dissection of extracted teeth as the auxiliary technic.

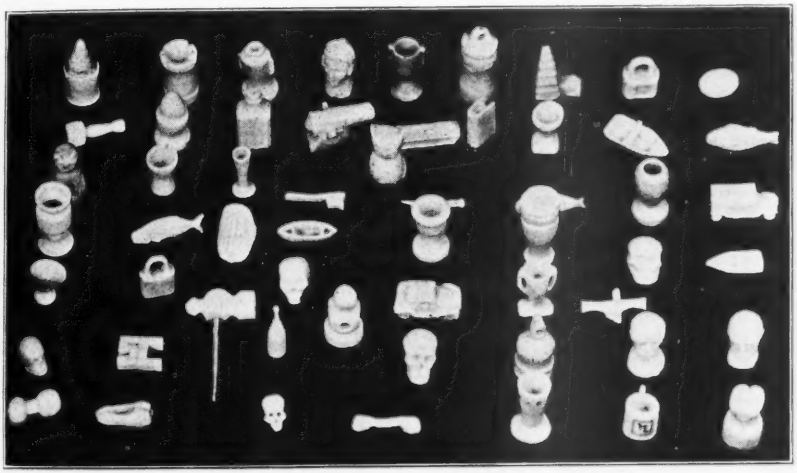


Fig. 1.—Wax sculpture. At the beginning of the freshman year, the student is required to carve a figure in wax, choosing his own subject.

At the end of the course, the student often considers that "one subject is out of the way."

Is the segregation of a subject in this manner conducive to the best teaching? Is not dental anatomy, as we understand it, a link in the chain of the fundamental principles of undergraduate training? Somewhere along the line of teaching,

*Read before the American Association of Dental Schools, Chicago, Ill., March 26, 1929.

we must confess, there is insufficient correlation in the application of the study of tooth form to the functional needs of the individual.

The physiology of the masticatory apparatus has been left largely to the divisions of prosthodontia and orthodontia, yet, in dental anatomy, we are dealing with the actual service units of mastication, with but little consideration of their function. The various divisions of

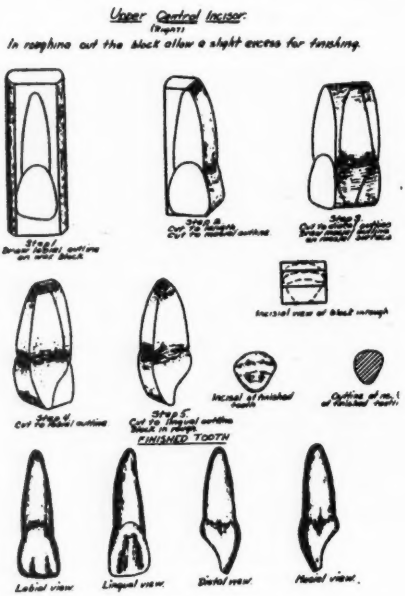


Fig. 2.—Tooth sculpture and odontometrics; carving of individual teeth in wax, using charts, drawings and specifications as to measurements.

dental teaching are thereby handicapped in that valuable time must be consumed by each department in teaching fundamentals pertaining to (normal) function; whereas, a foundation obtained in the beginning and accepted by all divisions would necessitate only a brief review and application of the fundamentals to the principles of the subject at hand.

A much better understanding of the connecting rod of an automobile engine is obtained when its place, relationship and function are demonstrated. Its form and construction have a meaning, and are therefore not easily forgotten. Likewise, the form and description of an individual tooth are more easily retained when its relationship and function are understood.

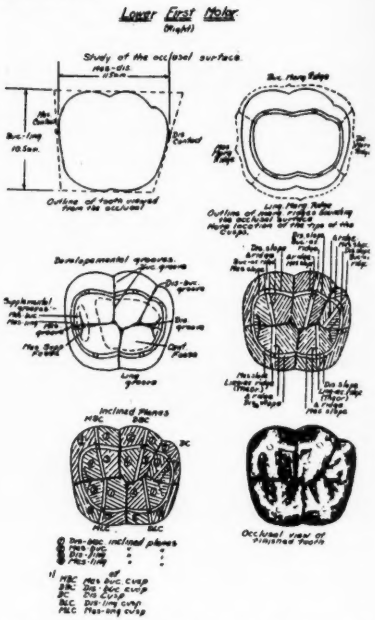


Fig. 3.—Tooth sculpture and odontometrics. (See Fig. 2.)

How may an extension of this subject be so managed that the form of the individual tooth will not be neglected, since the dental curriculum at the present time is already overloaded owing to limits of time and personal endurance? Is the subject of such interest to the student that he is able to absorb that

which is required, or does it partake of drudgery that demands wilful concentration and consequent "brain fag?"

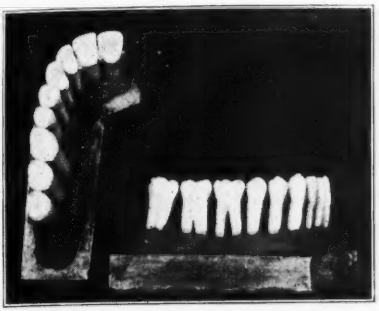


Fig. 4.—Mounting of wax teeth to study contact point and embrasure.

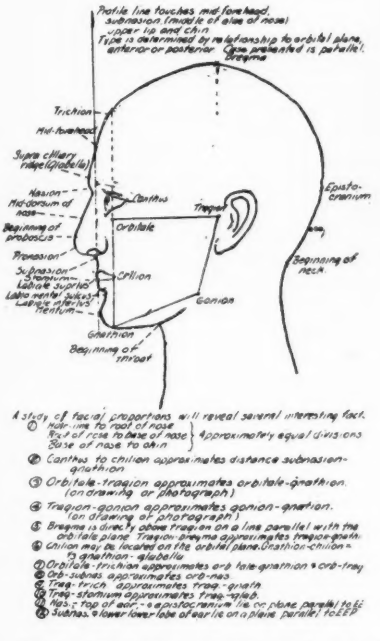

Profile line touches mid forehead, subnasion (mouth of sinus of nose) upper lip and chin.
Type is determined by relationship to orbital plane, anterior or posterior. Case presented is parallel.
Bregma
Trichion
Mid-forehead
Supra ciliary ridge (glabella)
Nasion
Mid-dorsum of nose
Beginning of proboscis
Prosion
Subnasion
Stomion
Labrale superius
Labio mental sulcus
Labrale inferius
Mentolabial
Gnathion
Beginning of throat
Tragion
Orbitale
Orbion
Gonion
Epistocranium
Beginning of neck
A study of facial proportions will reveal several interesting facts.
① Hair-line to root of nose / Root of nose to base of nose / Base of nose to chin } approximately equal divisions
② Canthus to chilion approximates distance subnasion-gnathion
③ Orbitale-tragion approximates orbitale-gnathion. (on drawing or photograph)
④ Tragion-gonion approximates gonion-gnathion. (on drawing or photograph)
⑤ Bregma is directly above tragion on a line parallel with the orbitale plane. Tragion-bregma approximates tragion-epistocranium.
⑥ Chilion may be located on the orbital plane. Gnathion-chilion = to gnathion-glabella
⑦ Orbitale-trichion approximates orbitale-gnathion + orbi-tragion
⑧ Orb-subnas approximates orb-nas.
⑨ Trag-trich. approximates trag-gnath.
⑩ Trag-stomion approximates trag-glab.
⑪ Nas-top of aur-epistocranium lie on plane parallel to ☐
⑫ Subnas + lower lower lobe of ear lie on a plane parallel to ☐

Fig. 5.—Chart for study of the face and head, locating certain landmarks and basic planes (cephalometry).

Are the pedagogic principles in keeping with the following established requirements?

1. Objective: A definite goal to be attained creating interest in the work of both teacher and student, with a consequent favorable reaction in student-teacher relationship.

2. Simplicity: The realization on the part of the teacher that the subject is new to the student and that elementary methods of presentation are essential.

3. Continuity: Sequence of thought and presentation with correlation in the technic laboratory.

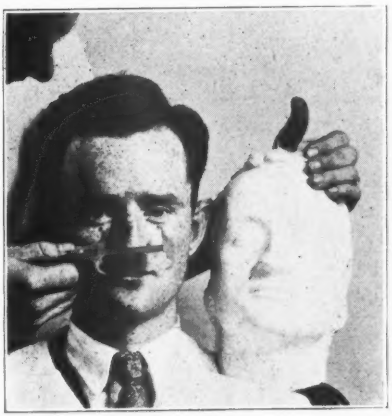


Fig. 6.—Cephalometry. Study of the face and head, locating certain landmarks and basic planes.

4. Emphasis: Determining factors which are of greatest importance and not "riding a hobby" of some minor detail.

5. Veracity: Statements proved by research and observation or generally accepted as authorative.

6. Specifications: A definite outline of study and technic requirements. The

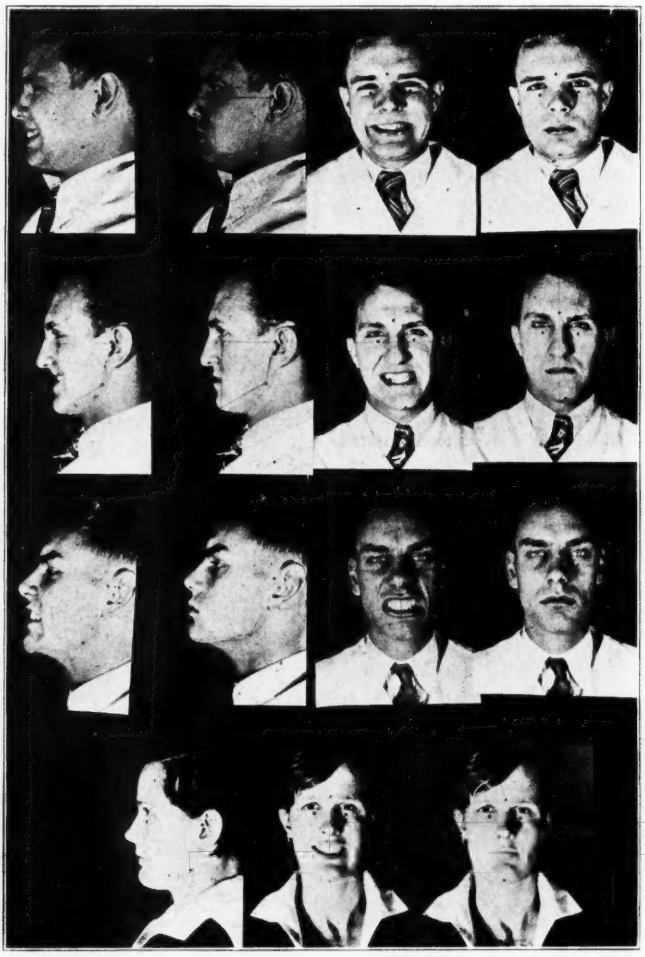


Fig. 7.—Photostatics. Four pictures are taken of each student in teaching the principles involved and the value of photostatic pictures.

use of drawings, charts, models and illustrations. Visual education is most appealing to the student.

7. Discipline and duty: Individual teacher-student contact in the laboratory. Variation in methods of individual dealing through a study of personalities.

8. Adequate assisting staff: Each member accepting a moral obligation to create a condition of harmony.

In the analysis and study of a subject which is unlimited in its ramifications, certain divisions and subdivisions should be established with due refer-

ence to the foregoing requirements of teaching principles. The following methods have been used and established in the University of Southern California as a course under the heading of dental anatomy. It is admitted that the present time schedule requires a concentrated effort on the part of both student and teacher, and that an extension of hours would greatly facilitate the elucidation of certain fundamental principles. Under the present conditions, at that, the proof that the experiment is successful is evident in the increased interest of the student as more advanced divisions are undertaken.

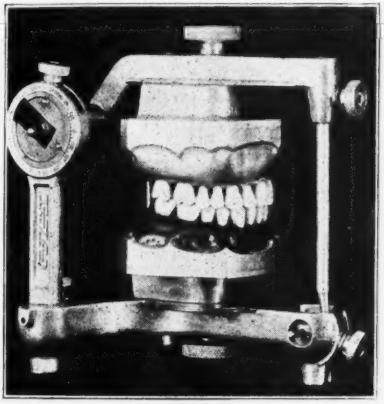


Fig. 8.—Occlusodontia; carving of neumanite teeth (full arches) and construction of a typodont demonstrating tooth form, arch form and balanced functional occlusion.

1. Wax sculpture: (At the beginning of the freshmen year the student is required to carve a figure in wax, using his own imagination and ingenuity in selecting his subject.)

2. Nomenclature: A grouping of the terms, with definitions, which pertain to the subject of dental anatomy.

3. Detailed anatomic description of the teeth: (Quizz methods.)

4. Tooth sculpture and odontometrics: The carving of the individual teeth in wax, one-half arch, using charts, drawings and specifications as to measurement; periodical laboratory examinations using colored wax.

5. Contact point and embrasure study; mounting of wax teeth in arch form.

Fig. 9.—Model shown in Figure 8 mounted for use in operative technic (sophomore year).

6. Cephalometry: The study of the face and head, locating certain landmarks and basic planes.

7. Cephalometric technic: Measurements of individual profile, making of a facial mask and cast.

8. Gnathostatics: Demonstration of Dr. Simon's Gnathostat and principles involved.

9. Photostatics: (*a*) Principles involved and value of photostatic pictures. (*b*) Taking of four pictures of each student.

10. Gnathostatic technic: Casts of maxillary and mandibular arches in lieu of gnathostatic casts; labial and two buccal casts with teeth in centric occlusion.

11. Study of arch form: (*a*) Pont's index and Hawley's method. (*b*) Cutouts—arch technic. (*c*) Measurements of individual teeth and arches.

12. Occlusodontia: (*a*) Study of charts and cutout exercises. (*b*) Carving of neumanite teeth (full arches) and construction of a typodont demonstrating tooth form, arch form and balanced functional occlusion. (This is to be used for operative technic in sophmore year.)

13. Gnathokinetics: (*a*) Theory of mandibular movements. (*b*) Study of temporomandibular joints (dissection demonstrations).

14. Gnathodynamics: (*a*) Study of forces of occlusion. (*b*) Function of the muscles of mastication.

15. Articulator analysis: (*a*) Study of elements and requirements of an articulator. (*b*) Demonstration of various articulators.

16. Gnathokinetic and articular technic: (*a*) Casts of arches using amalgam occlusal surfaces. (*b*) Gnathostatic orien-

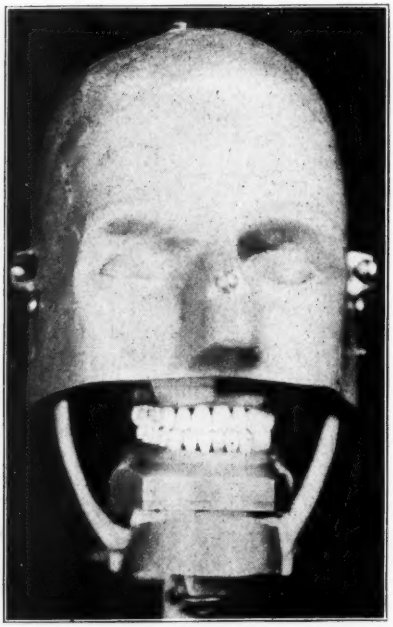


Fig. 10.—Front view of model shown in Figures 8 and 9.

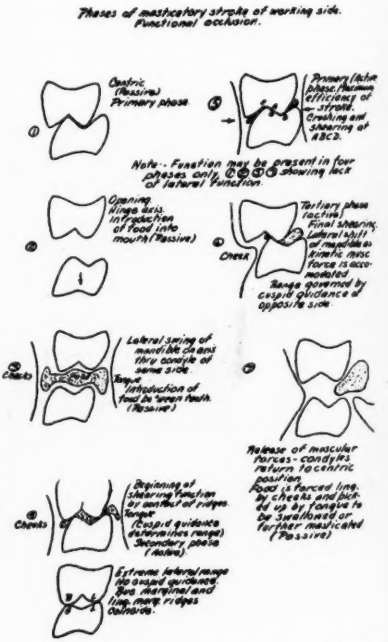

Phases of masticatory stroke of working side.
Functional occlusion.
Centric (Passive) Primary phase
Primary (Active phase) Maximum efficiency of jaw stroke. Crushing and shearing of ABCD.
Note - Function may be present in four phases only, ①②③④ showing lack of lateral function.
Opening. Hinge axis. Introduction of food into mouth (Passive)
Tertiary phase (active) Final shearing. Lateral shift of mandible as kinetic masc. force is accommodated
Check
Range governed by cuspid guidance of opposite side
Lateral swing of mandible carries thru condyle of same side
Check
Beyond. Introduction of food to grasp teeth. (Passive)
Release of muscular forces - condyles return to centric position. Food is forced lingually by cheeks and picked up by forepile to be swallowed or further masticated (Passive)
Beginning of shearing function or contact of ridges. Tongue (Cuspid guidance determines range) Secondary phase (Active)
Extreme lateral range developed guidance. Bucc. marginal and ling. marg. ridges coincide.

Fig. 11.—Chart used in the study of forces of occlusion.

tation in articular mounting; use of split cast. (*c*) Check-bite technic. (*d*) Setting of articular and controls. (*e*) Analysis of individual functional occlusion.

17. The function of the masticatory apparatus (lecture).

18. Case study of student: Drawing technic.

Questionnaire. Photographs. Profile drawings.

Fig. 12.—Photostatic photographs mounted for use in case study of student.

Odontometrics, gnathostatics and individual functions.

19. The deciduous teeth: (*a*) Chronology of development, calcification, etc. (*b*) Cutout exercises, with a specified age as the student's problem. (*c*) Preventive dentistry. (*d*) Carving of deciduous teeth according to specifications and descriptive anatomy.

20. Tooth morphology. (*a*) Microscopic observation of structures of extracted teeth. (*b*) Tooth dissection. (*c*) Drawings of dissections.

SUMMARY OF THE VALUE OF THE FOREGOING TEACHING METHODS AS A PREREQUISITE TO RESTORATIVE, CORRECTIVE AND PREVENTIVE DENTISTRY.

1. Nomenclature teaches the meaning, use and application of various terms

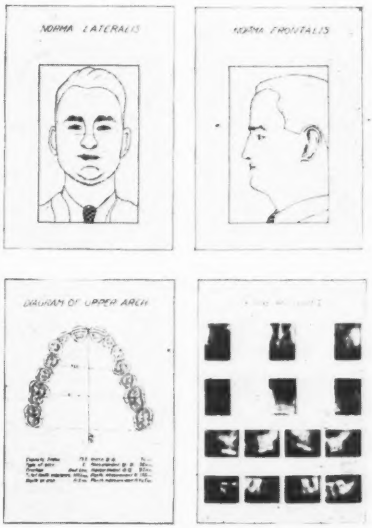


Fig. 13.—Drawings and films for use in case study of student.

which are to be applied to the study of the masticatory apparatus.

2. Dental sculpture and odontometrics teach the form, design, proportion, function and relationship of the individual teeth.

3. Cephalometry teaches the observation of the face and head and the location of various landmarks, with refer-

ence to the study of the individual norm and its variations.

4. Photostatic teaches a method of obtaining photographic records of the head, following a definite technic as to focal distance and landmark orientation in view of future photographs for comparative study.

5. Gnathostatics teaches the observation of arch form, the relationship of the

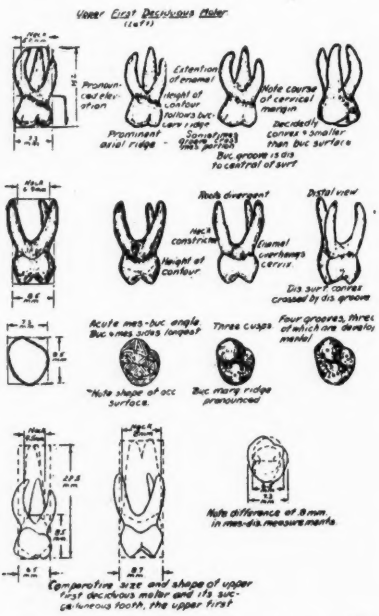

Upper First Deciduous Molar
(Left)
Pronunciation
Extension of enamel
Height of contour follows buc. cerv. ridge
Note course of cervical margin
Prominent axial ridge
Buc. groove is dis to central of surf
Roots divergent
Distal view
Neck constricted
Height of contour
Enamel overhangs cervix
Dis. surf. convex crossed by dis. groove
Acute mes.-buc. angle
Buc. cusp looks longest
Three cusps
Four grooves, three of which are developmental
Note shape of occ surface.
Buc. marg. ridge pronounced
Note difference of 8 mm. in mes.-dis. measurements
Comparative size and shape of upper first deciduous molar and its successional tooth, the upper first

Fig. 14.—Cutout exercises, with a specified age as the student's problem.

teeth to basic planes of the head and maxillomandibular relationship in view of their influence on the shape and form of the lower half of the face.

6. Occlusodontia teaches the relationship of the maxillary and mandibular teeth in ideal centric occlusion and the function of the various cusps and ridges in ideal articulation.

7. Gnathokinetics and gnathodynamics teach the movements of the mandible and the character of muscular and other forces with reference to their influence on the functional activity of the teeth. Divisions of this subject are: ((*a*) the morphology of the temporomandibular joints; (*b*) the positional relationship of the temporomandibular joints to the denture; (*c*) the functional activity of the

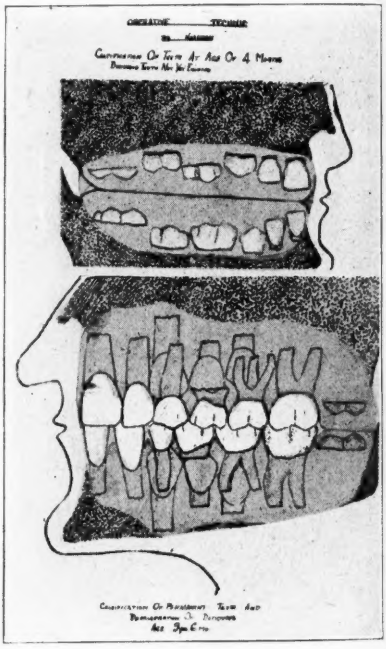


Fig. 15.—Cutout exercises, with a specified age as the student's problem.

muscles of mastication; (*d*) the component movements of the mandible and their combinations, and, (*e*) the arrangement and guiding factors of the teeth.

8. Articulator design teaches the analysis, the use, and the application of various

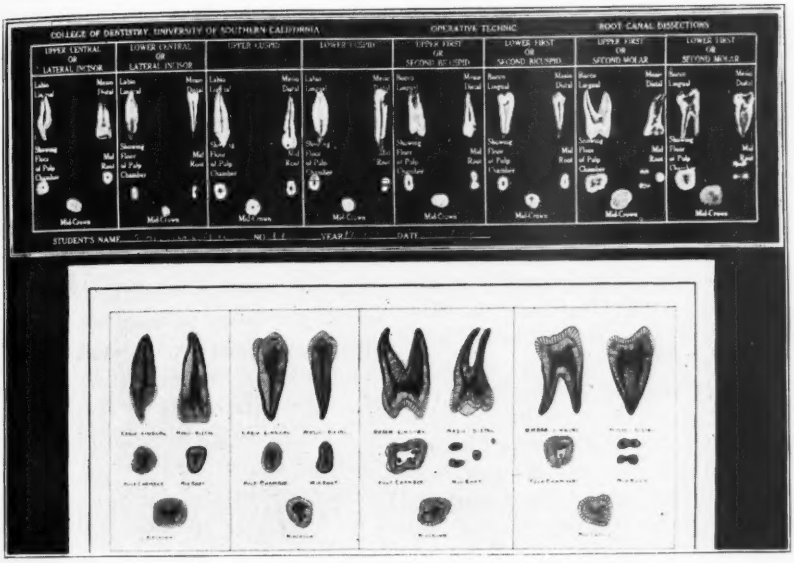


Fig. 16.—Drawings of sectioned teeth.

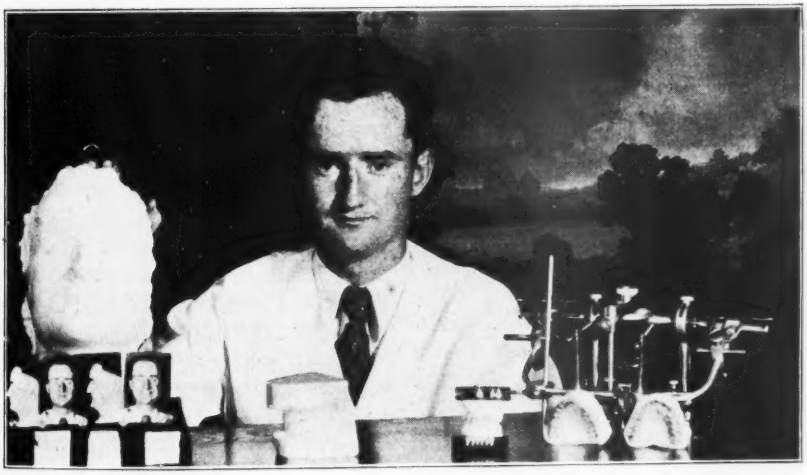


Fig. 17.—Student with facial cast, photographs, labial and buccal casts of teeth, gnathostatic models, porcelain teeth and articulator.

instruments for the purpose of applying individual gnathostatic and gnathokinetic findings to casts of the teeth. The casts are fixed in the instrument with the maxillary element the movable part. The maxillary teeth as a unit are therefore guided by the five controls of the articulator. These are: (1) an opening axis; (2) a vertical stop; (3) a right condyle element; (4) a left condyle element, and (5) an incisal element.

These controls are adjustable in proportion to the needs and requirements of the individual movements which are to be reproduced.

9. Gnathokinetic technic teaches the methods by which records of individual movements can be obtained and transferred to an articulator. These methods are classed as intra-oral and extra-oral according to the technic used.

10. Physiology of childhood and adolescent periods of tooth development teaches the value of preventive measures by observation of the deciduous teeth, the period of interchange and the growth and development of the arches.

11. Dental morphology teaches the macroscopic appearance of the structures of the teeth with reference to the function, form, density and relationship of the enamel, dentin, cementum, pulp chamber and root canals. A consideration of the immediate surrounding structures is included in this phase of study.

12. Physiology of mastication teaches the means, manner and function of structures involved in the act of preparing food for entrance into the stomach.

13. Diagnosis is recognized as the first and the most essential procedure in all branches of medical and dental practice. We believe the adoption of the foregoing methods to be an early step in this direction.

SOME RESPONSIBILITIES OF THE FAMILY DENTIST AND THE DENTAL SPECIALIST*

By JOHN A. McPHAIL, D.D.S., Cincinnati, Ohio

JAMES MACKENZIE, the great heart specialist, gave up a large practice in London and went back to Burnley, a little town in Scotland, where he again became a general practitioner. He said, "It is only the family doctor, not the specialist, who has the chance to learn about, to find all the ills, when they are not yet dangerous—at their beginning."

It seems desirable first to have a background of several years, no one can say how many, of general practice and for men naturally to drift into the particular line of specialization for which they seem best adapted, not only because of inclination, but also because of their ability. Most men who start specializing in this way are successful. After, say, five years of general practice, every family dentist should have some idea of the thing he can do well and the thing he is, in all probability, best fitted to do. No dental

*Read before the Section on Orthodontia at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 9, 1929.

specialist was ever handicapped by too much knowledge of general practice, but many a man who aspired to be a great specialist fell far short of what he might be, because of the lack of a broader understanding of the whole dental problem.

We all admire the conscientious, thorough, successful family dentist, just as we all love and admire the old family doctor. No one has ever taken their places and no one ever will. The family dentists are the men who see dental defects, not only malocclusion, but also all other pathologic dental conditions at their beginning. Many cases of malocclusion could be taken care of very nicely by the family dentist, if looked after in their incipiency. When malocclusion, for example, reaches the stage where even parents and friends notice them, they are often very difficult to treat. The well posted dentist should be able to recognize malocclusion before parents, who have much less dental information, do. Unfortunately, the medical and dental professions are more concerned with the later and more pronounced developments of malocclusion.

If you have been an up-to-date family dentist for a number of years and experienced all the joys, pleasures, successes, trials, tribulations and failures of such a practitioner, you will have a background that will never hamper you in case you specialize. The family dentist, if he wishes to give his patients the highest type of service and advice, must know something of orthodontia, periodontia and all the other dental specialties, although he may not do any of this type of work himself. It is much more difficult to be a 100 per cent family dentist than to be a specialist who "passes the buck" on everything except the particular dental activity in which he is engaged.

There is a tendency to start specializing without any particular background in general dentistry. We are like the small boy who thinks that he wants to be a policeman or a fireman: he does not know just why, but the uniform or something appeals to him. Instead of dentists going from specialization back to general practice as Dr. Mackenzie did, we find, in recent years, an increasing number of dentists looking forward to the time when they will be specialists.

A well-known writer says, "A specialist should be a dentist plus." It has often been said that specialization has a narrowing influence on our point of view. This is true when men who specialize show no interest in dental problems outside their own particular field. Specialization has no limitations. Almost every case will, in some way, become involved in another field. Therefore, it is important that we continue our interest in and show some appreciation of the other man's work and efforts. Often, we hear specialists say that the men in their communities are not interested in their specialty. If this is true, it is evident that we are not making our work interesting to the other man; and not only that, we are not taking an interest in the other man's work.

It is difficult to keep up the enthusiasm of the other man for our work, unless we ourselves are interested in his particular field. We hear about the narrowing influence of specialization, but how about the successful family dentist in a large city? We all know many family dentists who do no extracting, orthodontia, prosthetic work or children's dentistry. These men, it seems to me, have also narrowed their dental activities, until they are in reality on the border line of specialization. Before leaving this part of our subject, let us give the real

specialist credit for doing his work more proficiently than it has ever been done before.

This brings to mind another phase of specialization, that of consultation. It frequently happens, when dentists and physicians have joint meetings, that each group will accuse the other of a lack of cooperation with the result that patients do not receive the attention and service that they would have if the two groups worked together.

Before quarreling with them for failing to consult us, may we briefly discuss the subject of consultation between dentists. Formerly, every dentist was a law unto himself. He seldom consulted anyone else; but with a growing tendency for men to do one thing, it has also become necessary for us to consult each other. Not long ago, a friend of mine inquired of me why dentists never consulted each other. She said, "I have been to half a dozen dentists (she happened to be suffering from pyorrhea) and not one of them has suggested that another dentist be called in."

With communities spreading out over a larger area, areas which increase from year to year because of autos and better transportation facilities, the problem of personal contact between professional men becomes much more difficult. Especially is this true of dentists who seldom get away from their offices. Added to this is the fact that the average dentist is busier than he was in former years. Consultation between professional men would be much more successful if we would do as lawyers do, write down our opinions.

The patient very often gets the wrong impression and goes back and tells your confrère things you never said or meant at all. We often take it for granted that patients understand thoroughly what we are saying, when in reality we are using technical language that they do not understand. Write your consulting dentist the facts as you see them. If, for example, in mutilated cases, two men work on a case, would it not be much more satisfactory if the family dentist would write down what, in his opinion, would be the best method of supplying substitutes after the orthodontic work is completed and for the orthodontist to do the same thing?

For this purpose, it is advisable for both men to look over the patient, studying the profile, photographs, roentgenograms, the occlusion and the casts, and then to get together and each present his opinion, with his name signed, and discuss the case when the patient is not present. In this way, both men will have had an opportunity to study the case, independently and together, which would prevent much of this "passing the buck."

In order to do this, it would be necessary for orthodontists to know something about crowns and bridgework, fixed and removable appliances, etc., and it would also be necessary for the family dentist to know something of the possibilities and also the limitations of orthodontia, in order that each man might know what the other man can do and is talking about. It would seem to me that this would be much more satisfactory to the patient and would prevent a great deal of the "hit-and-miss" type of service.

The family dentist, when he refers a case, often says, "I don't know anything about orthodontia." That may be my fault or your fault; or perhaps he does not want to know anything about it. He washes his hands of the case and tells you to go ahead and do whatever you think is best. All orthodontists worthy of the name welcome the active cooperation of the family dentist. They need it, if the

patient is to be served with the highest type of service and the greatest possible efficiency. On the other hand, there is the family dentist who is so much interested in his patients that he leaves his work and accompanies them to your office. Sometimes, he asks you to come to his office. When the patient is in the chair, he usually says, "What do you think of this case," or "What would you do with this case?" Frequently, he has, before consulting you, told the patient what is the right thing to do. He has probably worked for this patient quite a number of years. He not only knows the patient, but the parents and the family in general. He also knows the particular type of occlusion of this individual family, and, in a general way, he knows the family history. If you, as an orthodontist, give this patient a hasty examination and then you tell the family dentist, in the presence of the patient, what you, in your great wisdom, would do that happens to be entirely different from what the family dentist told him, it seems to me that one of you, or both of you, are discredited in the eyes of the patient.

THE LOSS OF TEETH

By WILLIAM LINTZ, M.D., Brooklyn, N. Y.

THIS study was undertaken with a view of ascertaining whether the teeth are lost alike in both jaws; which are the first and which the last to go, and what percentage of teeth are lost by the average patient by the time he presents himself at the physician's office for examination. During the course of this investigation, other information was obtained which is of great interest not only to the physician but also to the dentist.

The material for this study comprises 301 consecutive office patients who presented themselves at my office with the usual complaints for which an internist is consulted. These were examined carefully regarding missing teeth and the condition of the remaining ones. As a rule, I found that if many teeth were missing, those remaining were liable to be in poor shape. The converse of this proposition was also true. I believe the interpretation of this to be that patients do not like to part with teeth, even though badly diseased, but would like to retain the natural teeth, in preference to having artificial ones, as long as there is no pain.

All these teeth were lost spontaneously or extracted, in both instances because of disease. Missing teeth can therefore be taken as evidence of dental disease. Rarely, healthy teeth were extracted on account of mistaken diagnosis or unsatisfactory therapeutic results. With many physicians and dentists, the wholesale extraction of teeth is still a panacea for every ailment that the human being is heir to. This attitude is, of course, wrong and is to be regretted. A sound principle to follow in this matter is that a tooth must be proved to be infected or diseased as a prerequisite for extraction for any condition. With modern scientific methods of investigation—the roent-

MISSING TEETH

Ages	A — Males — Number of Cases	A — Males — Upper Jaw — Central Incisor	Lateral Incisor	Cuspid	Bicuspid	Molar	A — Males — Lower Jaw — Central Incisor	Lateral Incisor	Cuspid	Bicuspid	Molar	A — Males — Total	A — Males — Average	B — Females — Number of Cases	B — Females — Upper Jaw — Central Incisor	Lateral Incisor	Cuspid	Bicuspid	Molar	B — Females — Lower Jaw — Central Incisor	Lateral Incisor	Cuspid	Bicuspid	Molar	B — Females — Total	B — Females — Average	C — Total No. of Cases — Number of Cases	C — Upper Jaw — Central Incisor	Lateral Incisor	Cuspid	Bicuspid	Molar	C — Lower Jaw — Central Incisor	Lateral Incisor	Cuspid	Bicuspid	Molar	C — Total	C — Average
5–10 years	6	..	..	..	..	..	..	1	..	..	5	6	1	5	..	..	..	..	..	..	..	1	..	..	1	1	11	..	..	..	1	..	..	1	..	5	7	1
10–15 years	5	1	..	..	..	..	..	..	..	..	..	1	1	4	1	..	..	..	4	..	..	2	2	9	2	9	2	..	..	..	..	..	..	2	2	10	1
15–20 years	10	2	2	..	..	4	..	..	..	2	7	19	1	10	1	..	..	2	3	..	..	..	6	12	1	20	3	2	..	..	4	..	..	2	13	31	1
20–25 years	4	2	2	2	4	7	2	2	2	4	6	33	8	28	4	5	2	14	13	..	..	..	12	29	79	2	32	6	7	4	18	20	2	2	2	16	35	112	3
25–30 years	6	..	..	1	1	2	..	..	..	1	4	9	1	25	..	3	1	10	27	2	1	..	2	25	71	2	31	..	3	2	11	29	2	1	..	3	29	80	2
30–35 years	9	..	..	..	1	13	..	..	..	1	11	26	2	42	11	15	17	40	78	2	2	5	35	99	304	7	51	11	16	17	41	91	2	2	5	36	110	330	6
35–40 years	13	1	2	13	31	2	2	2	12	33	98	7	29	13	11	11	40	61	2	2	4	23	87	254	8	42	13	12	13	53	92	4	4	6	35	120	352	8
40–45 years	11	3	4	4	9	21	..	..	1	9	18	69	6	23	24	23	22	58	77	7	8	8	26	79	332	14	34	27	27	26	57	98	7	8	9	35	97	401	11
45–50 years	9	1	4	3	6	22	..	..	..	3	17	56	6	23	24	23	23	52	74	16	16	15	45	91	379	16	32	25	27	26	58	96	16	16	15	48	108	435	13
50–55 years	9	13	10	9	20	33	10	5	4	12	23	139	15	21	26	25	25	60	97	18	17	17	47	77	409	19	30	39	35	34	30	130	28	22	21	59	100	548	18
55–60 years	6	4	4	5	9	16	4	4	2	9	20	77	12	16	17	19	17	43	67	14	7	6	29	64	283	17	22	21	23	22	52	83	18	11	8	38	84	360	16
60–65 years	2	2	2	2	4	7	2	2	2	4	7	34	17	19	36	36	33	68	102	32	30	32	71	106	546	28	21	38	38	35	72	109	34	32	34	75	113	580	27
65–70 years	3	4	6	4	5	15	4	5	2	5	15	65	21	5	8	8	8	16	24	9	10	9	20	30	142	28	8	12	14	12	21	39	13	15	11	25	45	207	25
70–75 years	3	6	6	6	12	16	6	6	6	12	17	93	31	1	2	2	1	3	6	2	2	2	4	6	30	30	4	8	8	7	15	22	8	8	8	16	23	123	30
75–80 years	1	2	2	2	4	6	2	2	2	4	6	32	32	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	2	2	4	6	2	2	2	4	6	32	32
80–85 years	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	2	2	4	6	2	2	2	4	6	32	32	1	2	2	2	4	6	2	2	2	4	6	32	32
Total Cases	97													252													349												

Total Number of Missing Teeth in Sequence

A — Males — Upper Jaw		A — Males — Lower Jaw	
Molar	193	Molar	189
Bicuspid	90	Bicuspid	78
Lateral Incisor	43	Central Incisor	32
Central Incisor	40	Lateral Incisor	29
Cuspid	40	Cuspid	23
Totals	406		351

A — Males — Both Jaws	
Molar	382
Bicuspid	168
Central Incisor	72
Lateral Incisor	72
Cuspid	63

Total Number of Missing Teeth in Sequence

B — Females — Upper Jaw		B — Females — Lower Jaw	
Molar	639	Molar	707
Bicuspid	410	Bicuspid	321
Lateral Incisor	172	Central Incisor	106
Central Incisor	169	Cuspid	109
Cuspid	162	Lateral Incisor	97
	1,552		1,331

B — Females — Both Jaws	
Molar	1,346
Bicuspid	731
Central Incisor	275
Lateral Incisor	269
Cuspid	262

Total Number of Missing Teeth in Sequence

C — Upper Jaw		C — Lower Jaw	
Molar	832	Molar	996
Bicuspid	500	Bicuspid	399
Lateral Incisor	215	Central Incisor	138
Central Incisor	209	Lateral Incisor	126
Cuspid	202	Cuspid	123
	1,958		1,682

C — Both Jaws	
Molar	1,678
Bicuspid	899
Central Incisor	347
Lateral Incisor	341
Cuspid	325

gen ray, bacteriology, electrical reactions, etc.—a definite diagnosis can be established in practically every instance. When dealing with impacted teeth other requirements must, of course, be met for extraction.

Findings are summarized in the accompanying table.

A. There were ninety-seven males in this group. There is a definite increase in the loss of teeth between the ages of 35 and 40 years and another marked increase between 50 and 55 years. The apparent increase which occurs between 20 and 25 years is unreliable, since there are only four cases in this group. In the upper jaw, 15.67 per cent more teeth were lost than in the lower jaw. The teeth are not lost haphazardly, but in a definite order or sequence, which is practically the same in both jaws: molars, bicuspids, central incisors, lateral incisors and cuspids. The molars are the most frequent teeth lost and the cuspids the least frequent and the last to go.

B. There were 252 females in this group. There is a definite increase in the loss of teeth in the female between the ages of 30 and 35 years and 40 and 45 years. In the upper jaw, 16.60 per cent more teeth were lost than in the lower jaw. The sequence for the loss of teeth in both jaws was the same as in the males: molars, bicuspids, central incisors, lateral incisors and cuspids. Again we see the molar as the most fragile tooth and the cuspid, the most hardy one.

C. Considering the 349 cases, composed of males and females, we find that there is a definite increase in the loss of teeth at the ages of 30 to 35 years and 50 to 55 years. The teeth are lost in the following sequence: molars, bicuspids, central incisors, lateral incisors and cuspids. In the upper jaw, 16.40 per cent more teeth were lost than in the lower jaw. Although in the mouth there are only three times as many molars as cuspids, there are five and one-half times as many lost as the cuspid teeth.

MISSING TEETH

A. In sixty-nine nonpregnant women, 161 teeth (14 per cent) were missing from the upper and 152 (13 per cent) from the lower jaw, a total of 313 teeth (14 per cent).

B. In 108 males, in the upper jaw, 385 teeth (22 per cent) were missing, and in the lower jaw, 309 (17 per cent); a total of 694 teeth (20 per cent).

C. In 184 women with a history of pregnancy, in the upper jaw, 1,394 teeth (47 per cent) were missing, and in the lower jaw, 1,224 (41 per cent); a total of 2,618 teeth (44 per cent).

In a total of 253 females, in the upper jaw, 1,555 teeth (38 per cent) were missing, and in the lower jaw, 1,376 (33 per cent); a total of 2,931 teeth (36 per cent).

In a total of 361 cases, in the upper jaw, 1,940 teeth (33 per cent) were missing, and in the lower jaw, 1,685 (29 per cent); a total of 3,625 teeth (32 per cent).

From these data, we see that teeth of women who have never been pregnant are retained longest. Only 14 per cent of these teeth were lost. Males show a loss of 20 per cent of their teeth. Women who have been pregnant show the greatest ravages, with a dental loss of 44 per cent. In the entire group of 361 cases, composed of men; pregnant and nonpregnant women, and children, 32 per cent of the teeth were missing.

SUMMARY

1. Needless extraction of teeth can be avoided if modern diagnostic methods are employed.

2. The female loses her teeth five years earlier than the male.

3. About 16 per cent more teeth are lost in the upper than in the lower jaw. This is true in both male and female.

4. Both sexes lose the teeth in a definite sequence: molars, bicuspids, central incisors, lateral incisors and cuspids.

5. The molar is the most fragile tooth and the cuspid the hardiest.

6. Three hundred and sixty-one patients lost 32 per cent of the teeth.

144 Joralemon Street.

The Journal of the American Dental Association

58 East Washington St., Chicago, Illinois

C. N. JOHNSON, Editor

Published by the American Dental Association

All expressions of opinions and all statements of supposed facts are published on the authority of the writer over whose signature they appear, and are not to be regarded as expressing the views of the American Dental Association, unless such statements or opinions have been adopted by the Association.

Communications intended for publication in the scientific or literary pages of THE JOURNAL should be addressed to the Editor. All advertising or business matters should be sent to the Business Manager.

Subscription is included in the annual membership dues. To nonmembers living in the United States or its possessions, the price is $2.50 a year in advance; Canada, $3.00; Australia, $4.00; other countries, $3.25. All foreign subscriptions are to be paid in United States money.

Editorials

PUT IT ON RECORD

Hearsay no longer passes muster as evidence in the consideration of any scientific problem. The written word is the only authoritative statement that stands for anything in establishing a scientific fact. Men may misconstrue the spoken word and there may be many differences of opinion over what was said or what was not said; but that which is written or printed stands as an indisputable record that cannot be argued away.

We have reference in particular to the discussions of scientific papers read before societies. Those who are appointed to discuss papers of this character should provide themselves with a written discussion in advance of the meeting, and every argument should be so stated that it cannot be misunderstood. Speakers are unfortunately in the habit of talking on a paper without due consideration of the statements they are making, and there is no way of checking their remarks as to intent or accuracy unless the discus-

sion is written. By this, it is not meant that the discussion of every paper calls for a written statement. There are papers of such a general character and dealing with topics that have little to do with scientific findings that they, of course, do not call for written discussions, and often the very best discussions arise spontaneously, on the spur of the moment; but when the establishment of a scientific fact is imminent, impromptu remarks that are not recorded furnish little evidence that is of real value.

Discussions for the most part should be brief and strictly to the point. In some instances, discussions occupy almost more space than the papers discussed, and thus are disproportionate and out of place. The discusser should aim merely to clarify the subject outlined by the essayist, and not reach out into divergent avenues for the purpose of exploiting some pet theory. The dominant thing is the paper and not the discussion. We can understand how at times a speaker in discussing a topic in which he is vitally interested is carried away with the subject and speaks longer than he intended, but this will seldom happen if the discussion is carefully prepared in advance and it will never happen if the discussion is written.

Rambling discussions in which the speaker wanders off into a plethora of words without accompanying ideas should no longer be tolerated in society proceedings. Time is becoming more and more an important consideration, and should not be wasted in useless or random talk. In other words, those who are appointed to discuss papers should carefully prepare themselves in advance, and to this end the essayist owes it to the discussers to furnish them with a copy of the paper, and thus contribute to good team work in the presentation of the subject. There is a real moral obligation incumbent on any man who accepts a place on a program to see to it that the time occupied is profitably spent, and this cannot be done without reasonable preparation in advance. The profession is becoming justly intolerant of speakers who seek a place on a program for personal exploitation or self advertising. Neither is there much charity for careless or slip-shod methods of presentation. Ideas should be put on record for future reference, where they must stand or fall on the printed evidence. When this is done, our

speakers will not be so careless in making statements, and the profession will be better served.

UNFORTUNATE ADVERTISING

Complaints are beginning to be heard regarding the advertising policy of some of our professional journals. There is a growing feeling that some of the advertising is detrimental to the best interests of the profession, and serves to hinder the proper development of dental materia medica by placing around unworthy and unscientific preparations an aura of respectability that they by no means deserve. Forward-looking practitioners appreciate that honest and well-directed advertising is a valuable means of informing the profession of products worthy of their attention. But they also are aware that intrinsically dishonest advertising, either by advertising scientifically worthless preparations or by misstatement of fact, is a perversion of editorial license, and a disgrace to any profession which tolerates it.

There is enough information available, both scientific and regulatory, to make possible an honest and judicious selection of products for advertisement and the statements contained therein. The situation might be excused if there were no such information, but since the publication of the exposés from the A. D. A. Bureau of Chemistry in THE JOURNAL, conscientious practitioners may well question the motives and policies of those who carry such advertising. The A. D. A. Bureau of Chemistry is willing to extend the benefit of its experience and information to those editors who feel they are not in possession of the necessary facts. In the long run, if any journal expects the support of the profession, it must prove its good faith by accepting only advertising that is honest.

DR. EDWARD C. KIRK RETIRES

The announcement has been made that, with the April number of our esteemed contemporary the *Dental Cosmos,* Edward C. Kirk, for many years its editor, retires and turns over the editorial control to L. Pierce Anthony, his associate. Dr. Kirk's extended connection with this publication has identified him with the profession in a very intimate way, and his ability as an editor has stamped him as an outstanding representative of the best there is in dental journalism. It is his purpose to retire and devote his time and energy to study and research along certain lines that have interested him for some time, and he assuredly carries with him the good wishes of the profession. In particular, his fellow editors will bid him good speed in his new work, with the hope that he has many fruitful and happy years ahead of him.

Dr. Anthony comes into his new responsibilities with mature judgment and an aptitude for the work possessed by few men in the profession. His long experience in the editorial department of the *Dental Cosmos* has fitted him to an unusual degree for the task before him, and we predict that there will be little change in the policy or quality of the publication under his direction.

We bid him a royal welcome to the fraternity of dental editors, and are greatly pleased that such an important post is to be graced by a representative in every way so worthy.

OUR CHILDREN

If we are to pass on to the generations of the future a proper heritage of health and happiness, we must begin now at the fountain source, and so guard our children against disease and deformity that they may be able to assume the responsibilities of life without the handicaps which too frequently have been the lot of humanity up to the present day. That is our problem, and it is a problem the solemn obligation of which cannot be ignored or shirked by any man or woman who has reached years of reasoning and responsibility.

COUNCIL ON DENTAL THERAPEUTICS

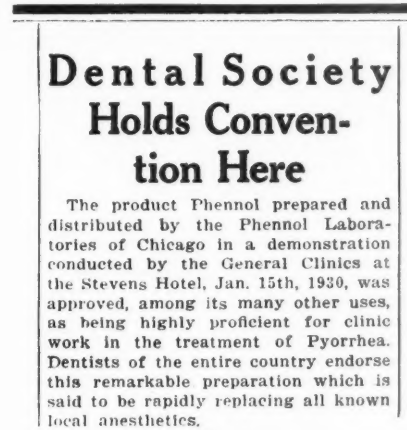
REPORTS OF THE COUNCIL

The Council has authorized publication of the following report.

SAMUEL M. GORDON, *Secretary.*

PHENNOL NOT ADMISSIBLE TO ACCEPTED NONOFFICIAL DENTAL REMEDIES

During the past several weeks, inquiries have been received by the Council concerning Phennol (Phennol Laboratories, Chicago, Ill.), a new addition to the ever-growing list of proprietary remedies.



Dental Society Holds Convention Here

The product Phennol prepared and distributed by the Phennol Laboratories of Chicago in a demonstration conducted by the General Clinics at the Stevens Hotel, Jan. 15th, 1930, was approved, among its many other uses, as being highly proficient for clinic work in the treatment of Pyorrhea. Dentists of the entire country endorse this remarkable preparation which is said to be rapidly replacing all known local anesthetics.

Fig. 1.

Statements contained in the advertising of Phennol closely parallel those made in connection with the promotion of Perdentin. The Council has already reported on Perdentin, declaring it inadmissible to Accepted Nonofficial Dental Remedies.[1]

Phennol is stated to be:

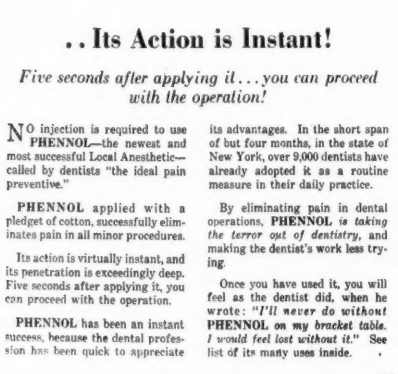
A colorless liquid, compounded of Benzly—Alc.—Nov.—Supr.—Trich—Menth. possessing highly analgesic and healing properties.

When examined in the A. D. A. Bureau of Chemistry, it was found that essentially a similar product could be prepared by mixing two volumes of chloroform and three volumes of benzyl alcohol. As such, it represents essentially an irrational and nonscientific mixture of a local and a general anesthetic.

1. Reports of the Council, J. A. D. A. 17:530 (March) 1930.

As an example of the unwarranted statements made in connection with the promotion of Phennol, there is reproduced advertising, presumably in the form of a newspaper clipping, which was sent to dentists. The clipping is herewith reproduced (Fig. 1).

A letter was addressed to the Chicago Dental Society inquiring as to the probity



.. Its Action is Instant!

Five seconds after applying it . . . you can proceed with the operation!

NO injection is required to use **PHENNOL**—the newest and most successful Local Anesthetic—called by dentists "the ideal pain preventive."

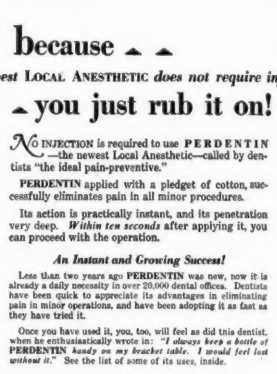
PHENNOL applied with a pledget of cotton, successfully eliminates pain in all minor procedures.

Its action is virtually instant, and its penetration is exceedingly deep. Five seconds after applying it, you can proceed with the operation.

PHENNOL has been an instant success, because the dental profession has been quick to appreciate its advantages. In the short span of but four months, in the state of New York, over 9,000 dentists have already adopted it as a routine measure in their daily practice.

By eliminating pain in dental operations, **PHENNOL** *is taking the terror out of dentistry,* and making the dentist's work less trying.

Once you have used it, you will feel as the dentist did, when he wrote: *"I'll never do without* **PHENNOL** *on my bracket table. I would feel lost without it."* See list of its many uses inside.



because ▲ ▲

This newest* LOCAL ANESTHETIC *does not require injection

▲ you just rub it on!

NO INJECTION is required to use **PERDENTIN**—the newest Local Anesthetic—called by dentists "the ideal pain-preventive."

PERDENTIN applied with a pledget of cotton, successfully eliminates pain in all minor procedures.

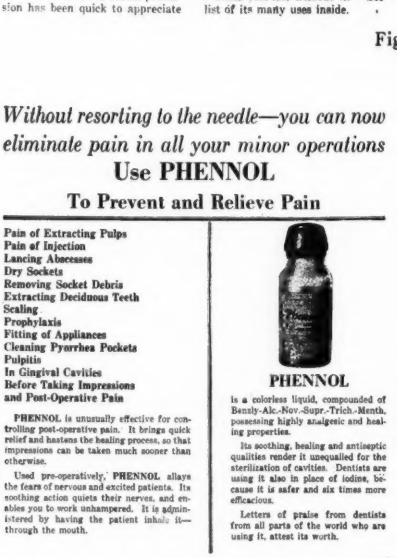
Its action is practically instant, and its penetration very deep. *Within ten seconds* after applying it, you can proceed with the operation.

An Instant and Growing Success!

Less than two years ago **PERDENTIN** was new, now it is already a daily necessity in over 20,000 dental offices. Dentists have been quick to appreciate its advantages in eliminating pain in minor operations, and have been adopting it as fast as they have tried it.

Once you have used it, you, too, will feel as did this dentist, when he enthusiastically wrote in: *"I always keep a bottle of* **PERDENTIN** *handy on my bracket table. I would feel lost without it."* See the list of some of its uses, inside.

Fig. 2.



Without resorting to the needle—you can now eliminate pain in all your minor operations

Use PHENNOL

To Prevent and Relieve Pain

Pain of Extracting Pulps
Pain of Injection
Lancing Abscesses
Dry Sockets
Removing Socket Debris
Extracting Deciduous Teeth
Scaling
Prophylaxis
Fitting of Appliances
Cleaning Pyorrhea Pockets
Pulpitis
In Gingival Cavities
Before Taking Impressions
and Post-Operative Pain

PHENNOL is unusually effective for controlling post-operative pain. It brings quick relief and hastens the healing process, so that impressions can be taken much sooner than otherwise.

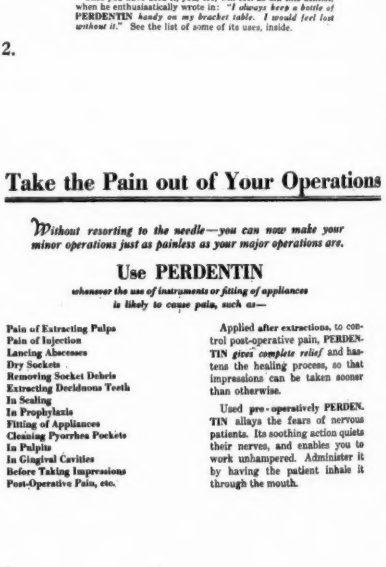
Used pre-operatively, **PHENNOL** allays the fears of nervous and excited patients. Its soothing action quiets their nerves, and enables you to work unhampered. It is administered by having the patient inhale it—through the mouth.

PHENNOL

is a colorless liquid, compounded of Benzly-Alc.-Nov.-Supr.-Trich.-Menth, possessing highly analgesic and healing properties.

Its soothing, healing and antiseptic qualities render it unequalled for the sterilization of cavities. Dentists are using it also in place of iodine, because it is safer and six times more efficacious.

Letters of praise from dentists from all parts of the world who are using it, attest its worth.



Take the Pain out of Your Operations

Without resorting to the needle—you can now make your minor operations just as painless as your major operations are.

Use PERDENTIN

whenever the use of instruments or fitting of appliances is likely to cause pain, such as—

Pain of Extracting Pulps
Pain of Injection
Lancing Abscesses
Dry Sockets
Removing Socket Debris
Extracting Deciduous Teeth
In Scaling
In Prophylaxis
Fitting of Appliances
Cleaning Pyorrhea Pockets
In Pulpitis
In Gingival Cavities
Before Taking Impressions
Post-Operative Pain, etc.

Applied after extractions, to control post-operative pain, **PERDENTIN** *gives complete relief* and hastens the healing process, so that impressions can be taken sooner than otherwise.

Used **pre-operatively PERDENTIN** allays the fears of nervous patients. Its soothing action quiets their nerves, and enables you to work unhampered. Administer it by having the patient inhale it through the mouth.

Fig. 3.

of the statements in this advertising. The Council is advised that the Phennol Laboratories occupied no space in the commercial exhibit and had no connection whatever with the meeting. The Phennol Laboratories, furthermore, had no authority to use the name of the Chicago Dental Society and the statements made in the advertising were entirely unwarranted.

In order that dentists may be acquainted with the similarity of advertising for Perdentin and Phennol, advertising of both is reproduced side by side. (Figs. 2 and 3.)

Possibly the Phennol Laboratories can explain to the profession the similarity of the advertising. In the meantime, scientific dentists will not allow themselves to be deluded by the improbable claims of another addition to the ever-growing list of nonscientific and unnecessary preparations.

Since Phennol is a secret, proprietary mixture, without originality in composition, and the therapeutic claims for it are greatly exaggerated, misleading and unwarranted, it is declared inadmissible to Accepted Nonofficial Dental Remedies.

BUREAU OF DENTAL HEALTH EDUCATION

SERVING THE CHILD IN DENTISTRY*

By FLOYDE EDDY HOGEBOOM, D.D.S., Los Angeles, Calif.

VEEDER'S definition of preventive pediatrics is "knowledge that will enable a child to be well born, to come into the world strong and healthy, to thrive lustily and without halt during infancy, to develop and grow in a normal way during childhood, to be able physically and mentally to attain a sound education, to acquire good habits of living and avoid bad ones, to avoid psychologic abnormalities so that he can adjust himself to his social environment, to pass through the difficult period of puberty and adolescence into a sound normal maturity, to prevent by scientific measures so far as we are able the infectious diseases of childhood." These are also some of the aims and objects of preventive dentistry.

In supplement to this definition, I would say that prevention as applied to dentistry means a minimizing of those adverse conditions of life that tend to shorten the period of dental efficiency.

To fulfil the scope of these two definitions, child specialists in departments of medicine and dentistry must cooperate. The child health program is an international one and must be approached by three grand divisions of workers: 1. Public health specialists who organize and direct this special work, in a nation, state, county, or city health board. 2. Research workers. 3. Practicing child specialists who apply the best scientific treatment devised by the research worker.

GENERAL CONSIDERATIONS

There are general methods of approaching this problem which must be adapted to the particular country, state or city. Through federal aid in this country, conditions which affect the country as a whole are kept under observation by the Public Health Service of the United States. It is interesting to know the general divisions: 1. Divisions of Scientific Research. 2. Division of Domestic Quarantine. 3. Division of Foreign and Insular Quarantine and Immigration. 4. Division of Sanitary Reports and Statistics. 5. Division of Marine Hospitals and Relief. 6. Division of Venereal Diseases. 7. Division of Personnel and Accounts. 8. Nursing, Dietetic and Reconstruction Section.

Under each division are many subdivisions. In each division, some work bearing directly on child health conservation is being done. For instance, under the Division of Research, work on mottled enamel was undertaken in Bauxite, Ark. Again, under the Division of Marine Hospitals and Relief, are reported

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 10, 1929.

twenty-eight full time and two part-time dental offices on duty, expending the sum of $153,524.56 on dental offices, assistants, supplies, equipment and overhead expense for 1928. There are also thirty-three contract dental surgeons who are appointed to supply the smaller marine hospitals and outpatient offices with emergency relief. But this significant sentence tells the story: "Only about one-half of the actual dental needs of beneficiaries are met."

Then, again, each state has more or less well-organized state health departments with large appropriations for child welfare, including dental supervision. The subdivision, such as the counties, have dental service in the more populous districts.

In Los Angeles County, we have a fine dental organization employing thirteen dentists, six dental hygienists and seven affiliated dentists. In the larger cities, fine dental health programs are functioning. We even have two large health-mobiles equipped with a dental room and eye, ear, nose and throat and general survey equipment for use among several of our city schools.

We would also call attention to the Oregon arrangement, where a certain percentage of the annual license fee is given over to public dental education by the state board of dental examiners.

We have next to consider the private office dental health service. This, because of its specialized character, should be the leaven which continually seeks to raise the standard of individual health service.

DIAGNOSIS

I believe that we are on the eve of some startling discoveries in dentistry and it is going to be in blood chemistry, endocrinology or nutrition. Before long, the dentist will need a colorimetric report on the hydrogen-ion concentration of both saliva and urine. From this, he will either outline a general diet for the child or adult, or he will refer him to a physician who is properly trained for this diagnostic work. Broderick, in his book on "Dental Medicine," has outlined this problem clearly. Harold Hawkins has confirmed this work to a large degree in his work on nutrition and caries at the College of Dentistry of the University of Southern California.

When the science of bacteriology was discovered, medicine thought that the end of all disease was in sight. But bacteriology seems to be yielding the field to biochemistry and physiology. This, of course, opens a new prospective on the problem of dental decay. Instead of studying immunity to caries, we must study those conditions which determine susceptibility to caries. Acidosis seems to be the predisposing cause of caries, while local fermentation of carbohydrates is the exciting cause. We must be familiar with the metabolic changes occurring in the body, the acid-alkaline base balance of the blood, the effect the endocrines have as governors of the processes, the mysterious powers, of the autonomic nerve systems. These are some of the complicated subjects that the child specialist in dentistry must master in the making of a diagnosis.

The pit and fissure theory has served us well, but we must go farther and find the general conditions that make for susceptibility in one person with open fissures, and immunity in another with open fissures; and the interpretation of these biologic reactions must of necessity change with the growth and development of the individual. Sex also influences variable reactions, which must be differentiated.

Malocclusion has received a great deal of attention from the local point of view,

but lately we have had our attention called to the relationship the endocrine glands and the autonomic nervous system have to this matter. The greatest percentage of endocrine dental defects present themselves between the ages of 10 and 20, which is undoubtedly due to the fact that the gonads (testicles and ovaries) are activated during this period. It is therefore of peculiar significance that those who are serving childhood in dentistry should be able to recognize some of the outstanding dental defects due to endocrine disorder. There are three basic endocrine principles, according to Engelbach, which relate to us as dentists:

1. Lack of thyroid function produces retarded embryonic differentiation and postnatal development of all osseous centers, including the tooth buds.

2. The harmone from the anterior lobe of the pituitary gland is the general harmone of all growth. An oversupply of it produces overgrowth, shown as an increase in size and density. A decrease in supply of its harmone of growth results in the opposite, i. e., miniature size and development, including teeth. In other words, every organ of the body is reduced in size, including the teeth.

3. Because the function of the gonads relates to the timing of the closure or the fusion of the epiphysis and regulates calcium production, these organs are important factors in the calcification of teeth and bones. Overfunction produces an early epiphyseal closure, preventing the long bone growth and resulting in a short stature and hypercalcification of teeth. A deficiency of these glands produces a very late fusion of the epiphysis, resulting in an overgrowth of the long bones, which causes an unusually tall stature and hypocalcification of the teeth. Hence, the time of closure of the epiphysis as determined by the roentgen ray is an index to dental calcification.

According to Rowe and Lawrence "The teeth, which might be expected to participate in disturbances of nutrition affecting the hair and skin, were described as definitely abnormal in 28 per cent of our patients. The variations from normal were: rapid and general decalcification, malposition or delayed eruption. The two latter conditions were always associated with other signs of delayed development; while decalcification was present in obese patients, with increased tolerance for sugar. The exact relation of carbohydrate and calcium metabolism is not known, but our findings bear out the idea held by many dentists that the teeth of individuals who consume large amounts of sugar are usually soft."

It should be a routine procedure during these early years to examine by roentgen ray the carpal bones of the wrist to check up on osseous development. This is a simple procedure and can be done with any ordinary dental x-ray unit. Roentgenographing the long bones of the body, such as the wrist bones, gives an index of the development. The best endocrinologists tell us that, soon after birth, these conditions can be prognosticated.

Many cases of mental deficiency of congenital hypothyroidism could be diagnosed at an early age if the dentist and physician could cooperate on some of the simple diagnostic signs of growth and development. A dentist cannot direct general medical treatment in these endocrine cases; but by dint of study, he can train himself to recognize some of the symptoms and cooperate with a physician who understands growth and development.

Many unpleasant results of orthodontic treatment would be avoided if some

of these underlying systemic conditions were taken into consideration; and many cases of malocclusion and dental caries will be prevented because the preschool child will be recognized as developing abnormally. There is only one way to tell the correct age of a growing child and that is by the appearance and fusion of the osseous centers. In the treatment of caries and malocclusion, chronologic age means less than physiologic or developmental age, and that can be determined only by roentgen ray examination of osseous centers, the carpals of the hands being used as an index.

All of these classes have dental symptoms which many of us have failed to analyze. For instance, the wide separation of the central incisors, so often seen, are not necessarily due to cord separation as we have been taught, but may be due to overstimulation of the anterior lobe of the pituitary gland, resulting in overgrowth of the maxillary bones, the teeth being thereby carried apart. Many cases of dental irregularity are due to hyposecretion of the thyroid at an early age.

We must not overlook the fact that no one diagnostic point justifies a snap judgment of endocrine disease, because nonendocrine diseases have many similar symptoms.

The family history must be considered, including the patient's personal history. Infections must be checked up, as these symptoms often date from some severe infection such as arises from diseased tonsils and adenoids, or influenza. Rapid changes in weight and height; periods of acceleration or unusual retardation or arrest of growth; modification of facial contour; increase in size of the hands or feet; changes in facial or body hair growth; headache and a tendency to tire easily; gastro-intestinal disturbances; changes in the menstrual function; irritability or other nervous reactions; mental retardation in school, and unusual behavior, most of these are objective symptoms that a dentist may draw enough of a conclusion from to warrant cooperation with a physician in a more complete laboratory diagnosis.

Rowe gives the following summary for physical examination which, he says, is "never more than suggestive":

1. The general body habitus, and particularly the relation of individual segments to each other or to the whole, are of real significance (i. e., height, span, etc.)

2. The localized distribution of obesity, as the girdle type found in pituitary disease; the fat body with thin legs of the patient with ovarian failure, and the generalized distribution in the hypothyroid individuals; which constitute a part of the foregoing.

3. The amount and distribution of body hair, with tendency to inversion in type of the secondary sex characteristic is significant.

4. The spacing development, and general appearance of the teeth. These should be carefully recorded as they may suggest disorders of the pituitary or thyroid or call attention to such conditions as rickets and congenital syphilis.

5. The shape of the nose. This may be suggestive of an endocrinopathy. The characteristic forms in acromegaly and cretinism are illustrations.

6. Marked asymmetry of the face and, less frequently, of other portions of the body, which may suggest those growth anomalies resulting from metabolic derangement.

7. The shape, appearance and consistency of the fingernails. These undergo modification, particularly in thyroid disease.

8. The general character of the skin and the presence of skin eruptions.

9. A tendency toward the development of varicosities in the lower limbs, which has been noted in pituitary disease.

10. Evidences of thyroid enlargement. These are as apt to be misleading as they are helpful. The diagnosis of thyroid disease (abnormal function) on the unsupported evidence of a goiter has done and is doing grave mischief.

Underlying successful treatment should be perfect accord with the parents and the child. The modern child is living under a rather strenuous daily routine. High pressure at school, music lessons, dancing, parties and dentistry, with its necessary subdivision, orthodontia.

The manipulation of teeth reacts on the brain and sympathetic nervous system, and so our technic must be elastic enough to circumvent pain, fright or psychologic effects of the surroundings. One who gives dental health service for children is not only filling teeth, but is building up self-assurance, and personality in this future citizen, and it behooves the dentist to study practical dental behavior.

After the diagnosis is made, the treatment must be outlined to fit the case. Cavity preparation for deciduous teeth of a necessity requires careful study or else the result is mediocre. In young children, if the normal duration of the deciduous tooth is several years, gold inlays should be used more frequently in Class II cavities. The results are better and more lasting. Next in order of durability and result, copper amalgam should be used; thirdly, silver amalgam, and, lastly, cements.

Good judgment will direct the order of these materials in the individual case. The main thing is to restore and keep the mouth in a state of health and function.

The study of growth and development, regulated by endocrine function, prevention of dental caries, calcium metabolism and nutrition, if they are to be understood and controlled, must begin at birth or during infancy. More thorough prophylaxis and early operative procedures must be instituted. The tiny pits and disintegrating fissures must be cared for earlier. But underlying all this must be the personal enthusiasm of the dentist. The practice of dentistry for children is hard, but greater opportunities lie in the field of preventive medicine of the next twenty-five years than in any other department of dentistry, and to serve the child in dentistry is to serve the nation and humanity for all time.

The progressive children's dentist must know diagnosis, and the new discoveries in blood chemistry and endocrinology. He must know growth and development, must know developing malocclusion and how to prevent it (and that means orthodontia), and, finally, he must know operative dentistry. Does any other field of dentistry have such possibilities, such scope of action; and does any other branch of preventive medicine promise such hope of accomplishment?

The duty, then, of the one serving children in dentistry is not only to advance knowledge in all subjects relating to the growth and health of the child but also to see that such knowledge is applied by the gradual education of the individual and, thereby, of the masses.

The time is here when our dental colleges must have endowments to meet the growing needs of dental education. The public will not be particularly keen to endow prosthetics or crowns and bridgework or even exodontia with all its thrills. But in this great wave of international child welfare and national health conservation, dentistry, if it meets the

challenge, can rightfully demand that the public endow our institutions for research in children's dentistry and health service to the child.

This is an opportunity that any dentist endowed with a spark of ambition can take advantage of. The road to Inspiration Point in Yosemite National Park is over the mountains and the going is not easy. But when we come out on the point, the prospect fully justifies our arduous labor. So, in our problem of serving the child in dentistry, the road is over the mountains, but the achievements ahead are without limitations.

THE VALUE OF A COMPETENT ASSISTANT

By JULIETTE A. SOUTHARD,† New York City

THOROUGHLY appreciating the vital necessity of "clean mouths for healthy bodies," we know that well-applied scientific care of the teeth and oral cavity plays a most important part in the general health conditions of every individual. The medical profession is now cooperating as never before with the dental profession in educating the general public through public agencies, as well as private practice, to the great need for intelligent care of the mouth and teeth in the prevention of decay of tooth structure and the maintenance of healthy oral conditions. Gone are the days when the teeth and general mouth conditions were ignored in the physician's diagnosis of a patient's ills. We have even observed the pendulum swinging rather far in the opposite direction and find some physicians placing the blame for all physical ills on the teeth of the patient, when very often the teeth are entirely blameless. This is the inevitable sequence to scientific practice. The scientist, in his eagerness to prove a theory, often becomes oblivious to certain conditions that, if carefully considered, would tend to modify his point of view. Be this as it may, education in the prevention of disease and disease conditions is on the up trend and of great moment in both the medical and the dental profession.

Following this thought of ever-increasing education for prevention, the dental service dispensed must be of the highest order, and this imposes on the dentist who would keep abreast of the times the necessity for constant study and careful consideration of his professional responsibilities. From this modern development of the dental profession and dental service has grown another phase of service, which we call "dental assisting." Year by year, step by step, we find the dental assistant becoming a more integral part of dental activity, and we note the evidence of her splendid contribution of service in the more efficiently conducted dental practices. No dentist who is alive to the welfare of his patients, and his own, attempts to carry on the details of his practice without the service of a competent woman assistant, and often he has several, this depending

†President, American Dental Assistants Association.

on the scope of his office. We may well paraphrase the time worn saying, "Show me a man's associates and I will show you what he is" by saying, "Show me a dental office without an assistant, and I will show you an unprogressive dentist."

Before we go farther in our consideration of the dental assistant and her relationship to the practice of dentistry, let us recall some facts that are not always remembered by those who are not entirely in sympathy with the dental assistant and the present position that she holds in dentistry. First, who created the dental assistant? How did she happen to become such an integral part of efficient dental service? Our answers are very simple. The dental assistant is the creation of the dental profession, and her service is the outgrowth of the dentist's need for help in his office. It may interest you to know that the first paper written about the dental assistant and concerning the possible value of her service in an office was written by Dr. Norman W. Kingsley, about 1880. Read before dental societies, it caused much unfavorable comment. This we have been told by members of the dental profession who recall the incident.

The paper was published in one of the dental journals of that day and this caused more comment. Dr. C. N. Johnson was another pioneer in the idea of associating in his office work a woman assistant. She entered his office about 1885, and served for thirty-two years, until August, 1917, when she "Quietly laid down her duties and passed serenely to the silent beyond." In the December number of the *Dental Review* for 1907, Dr. Johnson published an editorial entitled "A Little Girl," and this was republished as a part of his tribute to "Miss Alice," as she was affectionately called by all who knew her, in the *Dental Review* of October, 1917. We quote Dr. Johnson: "The most pronounced characteristics of this little girl's service is her loyalty. She is true as steel to the interests of her employer, no one ever did him a wrong that she did not try to right. I used the word employer but that was a mistake, no one "employs" this little girl. She simply helps the dentist conduct his practice and there is a community of interest in that office . . . and a spirit of reciprocal service which is most delightful. . . . The gospel of loving service, of work, of devotion to duty, though the heaven fall, is the one to regenerate the world." Words to be conjured with.

The dental assistants of bygone days, as a class, differed very materially from the dental assistant we know today. Their work and their responsibilities have increased a hundredfold, even in the past few years. When the employment of woman assistants was first broached to dentistry, about forty-five years ago, the profession was aghast at the idea, and those dentists who did follow this thought by employing a woman in their office as their assistant were looked upon by their confrères as men with strange ideas, and all kinds of arguments were advanced to dissuade them from their "new fangled" notions. The first assistants came into the offices as "office girls," maids or servants. No special aptitude was required, as the tasks were of the simplest. It does not take much scientific training to answer door bells, wield a polishing rag or push a broom across an office floor, and as these were the principal duties of the assistant in those early days, the young woman had plenty of leisure on her hands, which she employed in doing fancy work and reading novels. Happily, all this has changed, and just as education has raised

the standards of dentistry so has education raised the standards of the dental assistant. Because of the exacting requirements of our present-day dental service, the dentist must have educated, trained assistants, thoroughly capable of caring for any emergency. Probably, the best means that the patient has of judging the standing of any dental office is the assistant. If she is intelligent and capable, anticipating every need of the patient and dentist, it is an evidence of her good judgment and management. From the patients' point of view and for their satisfaction, no office should be without a woman assistant. Those dentists who do not recognize the wisdom of this plan are "penny wise and pound foolish." I even go so far as to predict that the day will come when patients will demand the presence of a woman in every dental office, just as they expect and demand the presence of a woman nurse in the physician's office when undergoing any operative procedure. Laws may even be drafted making this compulsory as a protective measure for both the dentist and the public.

We have said that the service of a dental assistant is a part of all dental activity. This may be a new thought to many of you, but in a profession dealing with health service, as does dentistry, all who are associated with it should know the history of the profession, its development, what it stands for and what it is trying to accomplish for the betterment of humanity. How can a dental assistant serve intelligently unless she knows all this, and how can she help to bring better results to the dental service? How can she fulfil her obligations to her employer, to his patients or to herself? It is absurd to expect efficient service from any one, in any line of endeavor, be it professional or business, unless one thoroughly understands what the profession or business in which one is engaged is doing or should do. It is this lack of knowledge that places so many "round pegs in square holes" and makes for inefficient, inadequate service, which tries the patience of us all when we go into a business or professional office in search of a commodity or advice. And the dental office is no exception, alas!

Besides having a knowledge of the history of dentistry, the aims of the dental profession and its ideals, the competent assistant must be versatile in many directions. She should have the educational background of at least the equivalent of a high school training, with elementary knowledge of bacteriology, physiology, organic chemistry and anatomy, supplemented by good business sense. If she has had training in a general business course, so much the better; she can use it to advantage. Plus this educational qualification, she should have a pleasing personality, coupled with a gentle, sympathetic manner. These attributes can be acquired if one is not endowed with them. Poise and tact are essential. These also can be cultivated if they are not inherent. Good judgment is essential, and may I say here that this is the result of "living." Calm, level heads are not found on the shoulders of the very young, so the dentist must not expect too much of his assistant if he has not chosen wisely, because he likes them "young and snappy," as it has been expressed to me.

Assistants perform a great variety of tasks in the day's routine of service. They might be classed as the "mechanics" of the service. I shall not go into the details of these routine duties which vary in every office, and are quickly mastered by an educated indi-

vidual, but I do desire to emphasize some of the essentials that are either forgotten or overlooked, such as her responsibilities as hostess, nurse, teacher, economist, laboratory technician and general office manager. She has been aptly called "the dentist's right hand," his "supplementary brain" and even "the dental office diplomat." Briefly, her duties are legion, and there is no limit to the exercise of her ability.

Why do we speak of the assistant as hostess? Charming, dignified and not effusive, is it not her duty to greet all patients and other callers who come to the dental office? And does not the opinion or first impression of new comers depend largely on the manner of that greeting? Is it not true that "a pleasant smile turneth away wrath"? Is it not the assistant's duty to dismiss the patients and others, with that sort of diplomatic dismissal that leaves no doubt in the mind that they have been the object of the most courteous treatment? Is it not the province of the assistant to impart to the office that something, let us call it "pleasing atmosphere," which makes the patient feel at home? Is it not her prerogative to plan those touches of artistry and refinement which make the office a pleasant place to come to and to be in while waiting for an appointment? Draperies, curtains, pictures, rugs—yes, even furniture—would be better chosen if left to her care, and much has been said about the reading matter on the waiting room table. A flower or two, a growing plant, is truly a touch of real hospitality in the thought of our hostess.

Of her duties as nurse, a volume might be written, but it is usually summed up by calling her the chair assistant. In this capacity, there are many opportunities for service. Every dental operation necessitates resourcefulness and judgment, coupled with womanly intuition. Many little attentions are bestowed on the patient that add to their comfort and to the efficiency of the operation; calming the fears or nerves of patients by a sympathetic touch or cheery smile, which is ofttimes forgotten by the dentist in his concentration on the problem at hand. Here, the assistant stands as guardian against the dangers of infection. She to a great degree assures the cleanliness of all that comes in contact with the patient and dentist, and while we know that a perfect cycle of asepsis is practically impossible in a dental office, intelligent precaution is a valuable safeguard, and the proper sterilization of instruments and equipment makes for the safety of all concerned. With children, the assistant is invaluable. She can provide such attractions as will distract the child's mind from the impending dental treatment, and, with intelligent conversation, can prepare the small patient for what is to follow. An entire paper can be devoted to the assistant and the child patient. Every assistant should understand "first aid" treatment. She should be able to care for patients affected by shock, fainting, hysteria, nausea, etc. She should know what to do for severe bleeding, hemorrhage, burns, simple fractures, etc., and also should understand poison antidotes. Accidents have happened in dental offices, and a second pair of hands and a second brain that know exactly what to do may be the means of helping the dentist to save a life.

As technician, there are many phases to the assistant's service. In the x-ray room, she can care for every phase of this diagnostic feature of dental service, from the taking of the picture to the finishing of it. I do not advocate that the assistant take the pictures, and it is

not because I do not believe that she cannot do it so well as the dentist; she can; but because I believe patients prefer that the dentist take the pictures. They come to him as an authority, for professional service and they are paying him, and not the assistant, for that service. The pictures that an assistant takes do not assume great importance in most patients' minds. In the laboratory, the assistant has a wide field for service. Her fingers are adapted to the minute details of mechanical dentistry, such as the making of gold inlays, crowns, bridges and other prosthetic restorations. She can pour plaster casts and can separate and articulate models. In an orthodontist's office, this is invaluable service. In those offices in which pathologic research is a part of the activities, a trained assistant can ably assist the dentist in developing his cultures and specimens. Some of the finest technicians in this field are women.

As a teacher, the assistant can ably second the dentist, and, under his direction, follow up his recommendations and instructions to patients; i.e., as to the value of consistent dental service; the proper use of the toothbrush; the need for regular prophylactic treatments; the importance of proper diet; the value of prenatal care, and the care of the deciduous teeth and that all important first permanent tooth, the so-called "six-year molar." She can explain the dental terms that are used by the dentist, making them understandable to the patient who does not wish to manifest a lack of understanding by asking the dentist to repeat what he has said. Many points in the case history that would never be mentioned to the dentist come to light in conversation with the assistant. Some patients never get over their dread of the dental chair or their awe of the dentist, but they will talk freely to the assistant, especially if she is of the more mature type.

As economist and office manager, the assistant is preeminently the person to whom these responsibilities should be delegated. In this capacity, the assistant cares for all the economic side of the office; she looks after the secretarial and bookkeeping tasks, the compiling of records and charts, the filing of statistical data and other information of importance; the collection of accounts, the paying of bills, the banking, the purchasing of supplies, etc. Hers is the "voice with the smile" that answers and makes all telephone calls. With ingenuity and tact, she handles all complaints and adjusts many differences that might try the temper and the patience of the dentist and patient and result disastrously to the practice. She is truly the "office diplomat" when she handles delinquent accounts, and she is far more successful in dealing with this problem than is the dentist.

Considering all these abovementioned possibilities for service on the part of a capable assistant, we wish to emphasize one big factor, and that is, that the only income-producing commodity that the dentist has at his disposal is time, plus his skill, and that this is only income-producing when employed in rendering actual dental service to patients. All the incidental details in the conduct of a dental practice which are apart from operative procedure are time-consuming but not income-producing. The acme of accomplishment for any dentist is to so blend his professional skill, art, knowledge, whatever you may wish to term it, with the time at his disposal so that they will form a perfect ensemble of income-producing power. That is the secret of professional success, and not the doing of odd jobs about the office that are better left in the

hands of a competent woman, the efficient dental assistant.

The successful office is that in which there is perfect teamwork between the dentist and his assistant. The dentist who makes a partner of his assistant is a wise man indeed. Whether the assistant is an asset or a liability depends on the good judgment of the dentist and his selection of the person who is to share his problems, his work and his responsibilities. The highest expression of the assistant's value is her ability to take from the dentist's shoulders every burden of the office procedure which is not actually operative procedure. Translating this into plain English, "Nobody yet ever got something for nothing and nobody ever will." The dentist is either going forward or backward. No one ever stands still. You must either be a leader or a follower; the follower gets the necessities in life, while the leader gets some of the luxuries, as the biggest profits always accrue to those who lead. Many dentists do not know how important to them an assistant can be, and many others see no good in them; but those who think wisely and well know that they must have able assistance, if they are to keep pace with the development of dental science, methods and manners, and take part in making the world a better place to live in, which should be the ambition of every educated professional man.

What right has any man or woman to a place on earth unless they do their part to help humanity? The dentist has his place, the dental assistant hers, doing their best with a contented mind and cheerful spirit, glad of the opportunity for healthful toil, fair play and a life of usefulness to others.

ASSISTANCE IN A SMALL TOWN OFFICE*

By VIRGINIA K. YOUNG,† Valentine, Nebr.

WE as dental assistants have many things in common. Primarily, the bonds which draw us together in our national organization are those motives set forth in our ideals: education, efficiency, loyalty and service. We have so earnestly endeavored to realize these ideals that, in our minds, they have become embodied in the one term "assistance."

Assistance varies in different dental offices according to types of specialization. We should not expect to find the same type of assistance in the office of an orthodontist as in that of a specialist in exodontia, even though we do expect to find the same ideals of service. Then, too, the responsibilities of the dental assistant are not the same in an office where there is but one assistant as in the office running under a more complicated system, where two or more dental assistants and laboratory technicians are required.

It seems to have become my duty to represent the assistants from the small

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†President, Nebraska Dental Assistants' Association.

towns—your country cousins, as it were. I wonder if you realize how numerous we are and how our environment compares with that of the city dental assistant. In other days, the country cousins wore a sunbonnet and rode in a spring buggy. Those who have not noted her progress think that she still does. Quite the contrary! She buys her chapeau in New York and drives her own Rolls Royce. However, this would apply to country cousins in general, and to dental assistants only figuratively.

These comparisons have been made merely to lead up to a point which I wish to register forcibly with you. It is this: The small town offices are, with but few exceptions, well equipped and up-to-the-minute in every respect. The one or two room office with a foot engine in one corner and a laboratory bench in another are fast becoming historical. They have had their place in the development of one of the most worthy professions of our time, but they are now considered a thing of the past. They have been replaced by scientifically planned suites of four or six rooms.

This step in progress has given rise to the necessity for a dental assistant even in a small town office. The duties devolving on her are similar in most respects to those in the one-assistant office of the city.

When anyone unfamiliar with our work questions me concerning it, I say "First of all, a dental assistant in this type of office must be a hostess." That statement usually brings from the questioner an exclamation of, "Oh, how odd! A hostess in a dental office!" "Yes, a hostess. She must possess those qualities of character and temperament which lend an unobtrusive air of hospitality." Then, I take the interested friend into the reception room and explain, "Every patient is a guest who looks to the assistant for greeting and farewell. That alone would not be sufficient. We want to make our guest as comfortable and happy as possible during a visit, be it brief or long. We hope to make the first impression both pleasing and lasting. So we manifest an interest in the visitor's mood and taste. We try to keep fresh garden flowers in the basket on the table during the summer season, and, at all times, we select our magazines as carefully as we would those for our own homes.

But that is only the beginning of our varied duties. Any day brings a round of assisting at the chair, laboratory work, telephoning appointments, developing roentgen ray films, sterilizing instruments and the other duties belonging to the one assistant in the general practitioner's office. I shall not attempt to dwell on these because the few points I could touch are already familiar to you.

I have chosen to try to picture for you why and how our work varies from that required in a city office. First of all, the practice of a dentist in a small town draws from a large territory geographically, however sparse the population. Many of our patients are farmers and ranchers, but they demand the very highest type of dentistry and the best class of service. They drive 20, 60 and even 80 miles to keep a dental appointment and arrive on time, whereas our patients in town are sometimes late.

It takes an elaborate system of correspondence to keep in touch with our out-of-town patients. And right there the assistant has a great responsibility, for a letter may either keep or lose a patient. When a new patient comes to the office, and we are making out the examination card, we ask, "Did someone refer you to this office?" Then, we take the name and address and write these lines to the

patient who referred a friend: "Dear Mr. Smith. We wish to thank you for referring Mr. Dawson to this office. Such expressions of confidence are greatly appreciated. We shall endeavor to merit them." This letter never fails to please and promotes a friendly relationship between doctor and patient. In one case, this letter form brought about the payment of an account which we had not been able otherwise to collect. Our regular collection letters are somewhat different, of course, but we try to make them tactful and yet to the point. We find that some mild reminder sent at frequent intervals brings better results than a single forceful letter.

In a small town or village, we meet many of our patients socially. This fact creates new problems and makes our work different from that of the assistant in the city office. We see the patient, not only in the operating room, but also at church, in the stores, on the street and at social affairs. It is of vital concern to us if one of our patients is ill or goes on a journey or buys a farm. We call on him if he is at a hospital and send greeting cards on various occasions.

One of our most appreciated courtesies we discovered quite by chance. We had just finished an extraction for an elderly little lady. She was alone and lived but a few blocks from the office. My doctor said "Just ask her to wait a few minutes in the retiring room, and then you may take her home in my car." While the little lady was resting, I seated the next patient in the second operating room. Then I took her home in the doctor's car. She was so appreciative that since then we have often taken patients to their homes after surgical extractions or cystectomy cases. This courtesy has proved to be a great kindness to the patient. It does not materially interfere with the doctor's schedule, and it affords a moment of relaxation for the dental assistant. You from the city offices may gasp at the very idea and think of it as running a bus line for the patients, but in the small town where the doctor's car is usually parked in front of his office, it is an entirely practical procedure. Opportunities for this type of service do not occur more often than twice a week, so that we are not overburdened.

Those of us who live in northern and northwestern Nebraska are called on to help in taking care of the dental needs of the Indians from the Pine Ridge and Rosebud Reservations in South Dakota. These people are not so easily handled, but how grateful they are for any service rendered! The Indian thinks of dentistry in the terms of pull out and put in, meaning extraction and bridgework. These early American descendants admire gold crowns and sometimes ask for them when they are not necessary. Our records show such names as Mary Red Road Good, Lillian Crazy Horse, John Spotted Elk and others quite as interesting and unusual.

The Indian woman, or squaw as she is termed, does not usually speak English. In her tribe, it is the man's place to do the talking. In one case I especially remember, I attempted to make a squaw understand that the doctor wanted her to swallow a small white tablet. I said, with accompanying gestures, "Please swallow this tablet," but her countenance retained its expression of placid indifference. It happened that I had learned a few Indian expressions, so I said in my best Dakota, "Pezuta kmikma napca iyonicipi ye." Her face brightened, and she complied with my request at once.

We have found that the Indian patient is more of a problem for the assistant than for the dentist, for, as my employer

expresses it, "They never come but that they bring the whole tribe along." The Indian pays his bills promptly; that is, he sends them to his uncle, and his uncle pays them promptly, although he requires an itemized statement, does "Uncle Sam!"

In these several instances and generalizations I have given, it is evident that the motivating factor in our routine of duties is a personal interest in people. For this reason, we are glad to write the courtesy letter, or take the patient home or speak to the squaw in her native tongue. And in all, we are eager to perform the useful service which we share with all dental assistants and nurses, that of aiding well-trained, ethical men in preventing and relieving human suffering.

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Civil Service: (Address the Civil Service Commission, Washington, D. C.)

When vacancies occur in the Army, Navy and Civil Service, announcement of such vacancies, the time, place and details in regard to examination are published in the dental journals, the pages of which should be consulted for details. In justice to

the Federal Government at Washington, D. C., it should be noted that vacancies in the United States Civil Service, the Navy and Army are limited and the requirements are exacting for professional men, so that comparatively few dentists are able to pass the tests, which are very comprehensive, as well as professional and technical in character, necessarily demanding the highest order of intelligence, skill, training and education, ingenuity, resourcefulness and operative ability. It should also be noted that there is an age limit; citizenship is required, and physical tests must be passed. Military precision is advisable, and there are many other stipulations which are not operative under civil law regulations for eligibility to examinations by a state board of dental examiners, for a license and registration in a state territory, district or island of the United States.

Changes in the name and address of the secretary-treasurer of a board of dental examiners or the equivalent officer, executive administrator of a department of state and the dental examiners make frequent revision of this roster necessary.

Union Station, Denver, Colo.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

The February issue of the *American Journal of Surgery* presents fifty-two articles on the subject of office surgery, covering 270 pages. In the leading article, "Conduction Anesthesia for Minor Surgery," George P. Pitkin calls attention to the fact that in 1915 there were ten articles published in American medical literature on local, conduction and spinal anesthesia; in 1920, there were twenty-three, and in 1929, 122 articles were published by American authors and more than twice that number by European physicians. Most of these were written for and by the specialist. In 1920, only three medical colleges in the United States were teaching the technic of local and conduction anesthesia. In 1908, 2 pounds of procain was sold in the United States; the present consumption is about 2,000 pounds a week. Because so many of the men now practicing received no instruction in the technic of local and conduction anesthesia, its use is regarded by many as something highly specialized, instead of a procedure of relative simplicity. The author cites the dangers of general anesthesia as possible ether pneumonia, lung abscess, shock and acute dilatation of the heart or stomach. The danger is particularly great if the patient has a heart condition, nephritis, asthma, pleurisy, pharyngeal obstruction, diabetes, hypertension or arteriosclerosis, or is a drug or alcohol addict. The expense and time involved in undergoing general anesthesia are to be considered. Of the advantages of local and conduction anesthesia, the author cites the simplicity and safeness of the procedure, the fact that no preparation of the patient is necessary, the freedom from postoperative gastro-intestinal disturbance and the elimination of fear and, for the most part, of shock, especially if ephedrin is used as an adjuvant. Local anesthetics may be administered to those suffering from tuberculosis, asthma, nephritis and heart conditions without altering the preanesthetic state. That the operator can administer it himself is a distinct advantage to the country physician and the industrial surgeon and in emergency cases. No cumbersome and expensive apparatus is necessary. It permits cooperation of the patient; a marked advantage when one is working without an assistant. The patient is able to adjust his position to aid the surgeon. Hospitalization is unnecessary, there is no edema of the operative field and, in the case of infected or inflamed areas, there is no danger of contaminating healthy tissue. The possibility of secondary hemorrhage is lessened. Postanesthetic nausea is seldom observed. Regular diet can be given at once. Conduction anesthesia blocks all afferent nerves; therefore, painful impulses are not transmitted, and there is no resultant shock. Patients suffer less postoperative pain. No change is produced in the blood chemistry or metabolic rate and the urine is unaltered. Some operators consider young children as undesirable subjects for this form of anesthesia, and epileptics, the insane and the definitely neurotic are ruled out. The author gives in detail the general and special technics for conduction and local anesthesia, with types of needles and their care, and the proper solution of the anesthetic to be used. The special technics for operations on the lip, chin, teeth, tongue, floor of mouth and mandible are given; also, the technic for injection of alcohol in facial neuralgia.

In discussing the use and abuse of antiseptics, Zachary Cope considers the subject with reference to four classes of wounds: 1. Clean. 2. Contaminated. 3. Deeply infected (including nearly all gunshot wounds). 4. Granulating. He concludes that all evidence is to the effect that antiseptics are not needed in clean wounds, but are exceedingly valuable in recently contaminated wounds; while in deeply infected and granulating wounds, they have little direct antibacterial action except in the case of the hypochlorites. The success of the Carrel-Dakin technic bears out clinically what the laboratory as-

serts. "Experimental work shows that it is exceedingly difficult to kill organisms in the depths of the skin. It is indeed doubtful whether it is possible to sterilize the skin without doing too much damage to the normal cells of the part. This fact should enforce the wearing of sterile gloves for operations." Some antiseptics are valuable for rendering the surface almost sterile; i. e., iodin, picric acid solution and some of the anilin dyes. Phenol has a special avidity for hair. The author says: "Mucous membranes are more delicate than skin and we are not aware of any reliable controlled clinical or experimental work which supports the view that microbes lodged in crypts or recesses can be killed by antiseptics. It may well be that organisms that have just been planted on the mucous membrane may be killed by an antiseptic application. This would be parallel to the treatment of a recently contaminated wound and supports the practice of applying a solution of silver nitrate to a conjunctival sac recently infected with the gonococcus. But the washing out of injected mucous cavities with antiseptic solutions has little to support it other than that the antiseptic keeps the fluid sterile."

A. R. Hollender presents the "Rational Uses of Physical Energies in Otorhinolaryngology." He concludes that while physical therapeutics in otorhinolaryngology is still more or less experimental, a vast amount of clinical evidence is available to prove the usefulness and rationale of certain physical energies in selected cases which come within the scope of the specialty. Ultraviolet energy has proved beneficial for tuberculosis and lupus of the pharynx, larynx and oral cavities and for some skin affections of the nose and ear. Medical diathermy is of value in acute and chronic forms of frontal and maxillary sinusitis, but must be employed with due regard for underlying factors, principally that of drainage when suppuration is present. Surgical diathermy is unquestionably the agent *par excellence* for the destruction of accessible new growths, whether benign or malignant, provided there is absence of metastatic involvement.

"The Role of Local Anesthesia in Office Practice" is discussed by Robert Emmett Farr, who suggests that any office may easily be equipped with the necessary apparatus for the routine employment of local anesthesia; and furthermore that when the physician realizes the advantages that may accrue from the routine use of local anesthesia in office practice, he will be surprised at its many advantages and wonder how he formerly carried on without this important adjunct. The use of local anesthesia is greatly in the interest of the patient, which must transcend every other consideration in professional practice. Many patients will submit to a needed operation promptly if it can be taken care of in the office, but put off having it done if hospitalization is demanded, on the ground of expense, time and a general feeling of antipathy toward entering a hospital.

Agranulocytic Angina: The attention of laryngologists has been attracted by descriptions and case reports of agranulocytic angina. Potts finds seventy-three cases reported in the literature. The disease is characterized by sudden onset of an acute injection of the mouth and throat, low white count with marked reduction or absence of the granular cells, high fever, often with chills, great prostration and rapidly fatal course, death occurring in three or four days. The white blood cells range from 5,300 to 400, consisting of lymphocytes, monocytes and, occasionally, polymorphonuclear cells. The red blood cell as well as the hemoglobin is usually normal. The throat injection progresses rapidly and assumes a gangrenous nature. The tonsils are always involved and, in most cases, the tongue and the gums. In one case, it extended to the larynx. A number showed vaginal ulcerations as well, as there is a tendency to attack mucous membrane surfaces. In no case was there noted any lymph gland hypertrophy. Cultures are not significant. It is more prevalent in women, of middle age. There is always a previous debilitating disease, which is significant. The end picture is usually a bronchopneumonia. As yet, no particular form of treatment has proved of any avail. The condition must be differentiated from pernicious anemia; aleukemic leukemia; sepsis; kala azar, noma. Thompson, Uren, Hueper and O'Connor likewise discuss the subject and report cases.—*New England J. Med.*, Dec. 19, 1929.

Foreign Literature

General Pathology and Pathologic Anatomy of Tuberculosis (Walther Fischer, Fortschr. d. Zahnheilk. [Leipsic: Georg

Thieme] No. 1, 1930, p. 28): Tuberculosis is one of the most devastating of diseases. In 1925, approximately 66,500 people died of this disease in Germany; that is, 10.7 persons of every 10,000 people. Of these, 8.9 died from tuberculosis of the lungs. In 1927, the death rate was 9.36 for every 10,000. If we compare the latest death rates with those of the past, we find that there has been a gradual decline except in the few years immediately following the war. In 1874, the rate was 32; in 1913, it had decreased to 13.65; in 1918, it mounted to 22.3. Since that time, the death rate has been gradually decreasing. Of interest are the figures gathered in England pertaining to the number of people that died from tuberculosis of the lungs during 1926. These were also classified as to age, so that we can see at a glance at what ages people are most likely to die from this disease. The total number of deaths were 30,198.

1- 5 years	458
6-15 years	891
16-25 years	6,919
26-45 years	12,880
46-65 years	7,891
66-75 years	1,004
Above 75	155

These statistics are based on clinical diagnosis. According to the pathologists, these figure do not offer any information as to the prevalence of tuberculosis, but merely tell us the numbers of people that have died from what has been diagnosed as tuberculosis. Pathologists contend that from 30 to almost 100 per cent of the people are at some time afflicted with this disease. A large percentage of the people have tuberculosis in a mild form and never know it. With the Pirquet test for tuberculosis, among the poorer classes of Vienna, Hamburgers found the following:

1- 2 years	9 per cent positive
3- 4 years	27 per cent positive
5- 6 years	51 per cent positive
7-10 years	71 per cent positive
11-14 years	94 per cent positive

We recognize chiefly three types of tuberculosis bacilli, humanus, bovinus and gallinaceus. The bovinus type is found in about 3 per cent of all cases. It is this type that is found largely in the primary intestinal tuberculosis of children. These cases are directly traceable to cow's milk. This type is also found in the tuberculous glands of the neck and in tuberculous infections of the skin. In lung infections, this type is seldom found. The humanus type is the organism responsible for most tuberculous lung infections. The gallinaceus type is found in people only rarely.

The most common way for the organism to enter the body is through the mouth and lungs, by aspiration; the next most common is by way of the alimentary canal, tonsils, stomach and intestines. A third and less common way is through the skin and mucous membrane. The least common way is through the blood stream. The infection reaches the fetus of the tuberculous mother through the placenta. The typical lesion produced by the organism is the tubercle; from this, the disease received its name. The tissues do not always react with the formation of tubercles; just how they react depends on the type, virulence and numbers of organisms. The tissues may show alterations with inflammatory reaction, exudative processes or productive tissue growth. When the organisms spread over the entire system through the blood stream, the condition is described as miliary tuberculosis. An older lesion usually precedes this type of tuberculous sepsis. Another type, which acts quite differently from the ordinary tuberculosis, is the condition known as septic *tuberculosa gravissima*. Death often occurs within a very short time. In its action, it resembles a serious case of typhoid infection. This particular disease seldom occurs in young people. Some contend that a tuberculous infection sometimes thus attacks those that had never previously been exposed to tuberculosis. The absence of any older tuberculous lesion supports this theory.

EMIL MUELLER, Chicago.

Pathology of Odontomas (A. W. Rywkind, Vierteljahrsschr. f. Zahnheilk., 1929, No. 4): The author describes an unusual case of odontoma, which is of especial interest because of the knowledge regarding the origin and development of this kind of tumor. A girl, aged 8 years, had a large hard swelling of the left half of the mandible, for which an exarticulation of this part of the mandible was performed. The specimen obtained consisted of a mass of bone, and on the surface, toward the mouth, there was a depression filled with a hard irregular substance which had the appearance of enamel.

The tumor took the place of the unerupted molars of this side, which were found to be involved in the pathologic growth. In a cross-section through mandible and tumor, a large cavity was found in the center lined with the irregular hard substance of the tumor. This hard tissue was surrounded by a capsule of connective tissue, and, on the outside the mandible, formed a heavy shell of newly formed bone. Histologically, it is evident that the tumor by its growth caused a continuous resorption of the inside of the mandible and a continuous periosteal deposit of the bone on the outside, swelling and enlargement of the mandible resulting. The hard substance consisted of dentin and enamel. The dentin was very irregular in structure, the tubuli running in different directions, and the enamel covered the surface of the dentin as well as lining the inside of small cavities and hollows in the mass of the tumor. The microscopic examination of the connective tissue around the tumor revealed numerous strands of epithelium. In some places, there were projections of the epithelium of the surface resembling a dental lamina; in other places, there were structures almost identical to tooth germs. Some of the latter showed a very complicated structure: ganoblasts and odontoblasts were in an atypical arrangement, which caused an interchange of enamel and dentin in all stages of development. This fact, namely, the occurrence of all stages of development in the same tumor, gives valuable information as to the formation and the development of odontomas.

RUDOLF KRONFELD, Chicago.

Oligodynamic Power of Silver, with Special Reference to Its Use as a Filling Material for Root Canals (Georg Stein, Ztschr. f. Stomatol., 28, 1930, No. 1): In his paper on filling root canals with metallic silver powder, A. M. Schwarz, of Vienna, describes the technic used in this operation.[1] He emphasizes that although formerly this method appealed to us for various reasons, there was not sufficient evidence to form a lasting opinion. The use of silver was especially suggested in consideration of its high oligodynamic power.[2] Stein made further investigations in this field, using cultures of streptococci that were brought in contact with metallic silver powder and renewing these cultures every day. He found a remarkable decrease in the bactericidal action of the silver powder. An amount of silver that, in the beginning, was able to kill streptococci after twenty-four hours lost this power if it was brought in contact with new cultures every day. In another series of experiments, Stein showed that hemolytic streptococci, when acted on by silver, lost their capacity to cause hemolysis. If these bacteria, after the loss of this power, were placed in a new culture medium, with no silver present, they regained their former power. This proved that the effect of the silver is merely temporary. From newer investigations, it seems that the oligodynamic power is based on a very slight solubility of the silver. This theory makes it seem probable that the oligodynamic power of the silver can be lost because of the changes on the surface, such as absorption or the formation of precipitates that may prevent further solution. Stein comes to the following conclusions: Silver powder is able to sterilize a bouillon culture of streptococci. If the same silver is used over and over, this property of the metal is lost. Some types of bacteria are not at all affected by the presence of silver. These bacteriologic tests show that silver is not superior to other root filling materials.

RUDOLF KRONFELD, Chicago.

Wandering of Teeth of Chamois and Deer (Siegmund Schuhmacher, Vierteljahrsschr. f. Zahnheilk., 1929, No. 4): Stein and Weinman found, in 1925, in their study of human jaws that all during life teeth migrate steadily but slowly forward. The alveolar bone is resorbed on the mesial side during this process, and new bone is deposited on the distal side. At the same time, the teeth are slowly moving toward the occlusal line and, as an evidence of this movement, we find a deposit of layers of newly built bone on the bottom of the alveolus. Schuhmacher studied these changes in the jaws of chamois and deer. These animals are herbivorous, and their molars are subjected to a great amount of wear (abrasion) on the occlusal surface. It has been observed that, in spite of this abrasion, the molars of these animals show a fairly uniform length throughout life. As it is fairly easy to determine the age of a deer by the

1. Current Literature, J.A.D.A., 16:1775 (Sept.) 1929.

2. Current Literature, J.A.D.A., 17:551 (March) 1930.

configuration of the horns, the author was able to collect jaws of animals of known age, from early youth to about 12 years of age. He opened the jaw by removing the outer plate of bone and studied the relationship between the teeth and the jaw. He found that each molar is continuously moving (wandering) toward the occlusal line (vertical wandering). In youth, this movement is compensated by a corresponding increase in the length of the root. After the root formation is completed, the entire tooth moves toward the occlusal surface. Thus, the distance from the root end to the mandibular canals is constantly increasing. The bifurcation is coming closer and closer to the alveolar margin and, in the case of a chamois buck of 12 years, was found to have passed the alveolar margin. In a similar way, the horizontal wandering has been studied by Schuhmacher on the maxillae of bucks of different ages. He found that the entire length of the row of bicuspids and molars is continuously decreasing during life. In young bucks, the length is about 69 mm., and, at 8 years, it is around 60 mm. This shortening, which is due to interproximal wear, is caused by a shifting of all teeth forward toward the median line. This movement corresponds to the shortening of the human tooth arch during life by the loss of tooth substance at the contact points, which is histologically determined by a steady, slow movement of all teeth toward the median line.

RUDOLF KRONFELD, Chicago.

MISCELLANY

BOOK REVIEW

A Manual of Exodontia. By M. Hillel Feldman, D.D.S., Chief of the Dental Department of Lincoln Hospital; Postgraduate Instructor in General Anesthesia, Allied Dental Council, New York City. Second Edition, thoroughly revised; 220 pages; illustrated with 203 engravings; price, $3.50 net. Published by Lea & Febiger, Philadelphia, 1930.

It is assuredly a recommendation of any volume to have the first edition exhausted as rapidly as was the case with Dr. Feldman's book. It is also a stimulus to the author toward higher endeavor, and thus Dr. Feldman has gone at his task of revision with determination and enthusiasm. One sentence in the preface merits much commendation. "Extraction, with a minimum of trauma to both the soft and bony tissues, is maintained as the supreme objective of the operator." With that as the chief tenet of his faith, the author has presented a book that may be considered a safe guide to practitioners young and old, and it is, therefore, logical that the major portion of the book is taken up with the operative procedures and technic of this work.

The author urges taking special note of the physiologic condition of the patient in anesthesia, and outlines some of the unfavorable symptoms, which should form a guide to all of those who use anesthetics. It is a safe book to follow and the text is well supported by good illustrations. The paper is good and the whole volume is very satisfactory.

CORRESPONDENCE

March 28, 1930.

To the Editor:

It has recently come to my attention that there is considerable uncertainty and misapprehension in the dental profession in regard to our views concerning the use of hexylresorcinol in the prevention of dental caries. Some time ago, we made the statement that, in certain cases, the use of hexylresorcinol as a mouth wash seemed to exert a distinctly restraining influence on the organisms of dental caries and in some instances entirely eradicated them from the mouth; furthermore, that hexylresorcinol was the most efficient in that respect of all the preparations tested.

In view of these observations, we hoped that this preparation might prove to be distinctly beneficial in the control of dental caries. To determine its value in this regard, we have observed three groups of children during the past year, all of whom used hexylresorcinol as a mouth wash twice daily. Two of these groups, numbering 274 children, were residents of orphanages. These children, in addition to receiving hexylresorcinol, were fed on a well-fortified, adequate, low-sugar diet. In them, it was found that, during the period

of one year, dental caries was almost completely arrested, there being but 5 and 6 per cent respectively in the two groups in which there was evidence of active dental disease. As these children had been subjected to both therapeutic and dietary measures, it was not possible to say which, therapeutics or diet, was most effective in the control of dental caries.

To throw some light on the effect of hexylresorcinol alone, a group of 104 children in a public school were given this drug as a mouth wash twice daily over a period of nine months. No attempt was made to alter the regular home diet. At the end of the nine months, it was found that 50 per cent of the children had active and extensive caries, quite as much as was found in a control group in an orphanage in which no measures of control were instituted. It was furthermore noted that, in a group of 159 children in an orphanage in which a good diet was afforded, but no hexylresorcinol, there were but 6 per cent who had active caries.

These data indicate that diet may exercise a very remarkable restraining effect on dental caries, but do not show that hexylresorcinol when used as a mouth wash had any appreciable effect on the disease. Further work is needed to determine whether or not it is possible to control dental caries by any form of antiseptic treatment.

If you will be kind enough to print this statement in the columns of THE JOURNAL, our present position in regard to this matter may be clarified.

Very truly yours,

R. W. BUNTING.

Ann Arbor, Mich.

BEWARE FAKE ANTISEPTICS GOVERNMENT EXPERTS WARN

"The clean-up campaign against fake antiseptics has been so effective that today the statements appearing on the labels of most preparations of this kind in interstate and import commerce are reasonably accurate," say drug control officials of the Food, Drug, and Insecticide Administration, U. S. Department of Agriculture.

The public is warned, however, to discriminate between the labeling on the package itself and the advertising in circulars, posters, periodicals, billboards and the like. The Federal food and drugs act does not control such advertising and some manufacturers are taking advantage of this situation to disseminate the crudest sort of misinformation regarding their products.

Constant surveillance is kept over the labels of the new crop of antiseptics by the Department to catch any fake or misbranded preparation as soon as it appears. Users of these preparations are told not to expect miraculous effects from the use of any antiseptic, such as a mouth wash, the chief result of which is a pleasant taste. Such a preparation remaining in contact with the tissues but a brief period does not destroy all germ life in the mouth, nor does it have any influence during the remaining hours of the day.

Of more than 1,000 supposed antiseptic preparations examined by Government chemists and bacteriologists during the past three years, less than 100 bore labels to which no exception was taken by officials. Two preparations actually contained live bacteria and many of the others were found on testing not to kill or prevent germ growth. Many effective antiseptics were found to carry unwarranted curative claims on the label.

The wide use of antiseptics and the continued attempts of unscrupulous manufacturers to sell fake preparations through unwarranted advertising not in harmony with the label claims has prompted the Department of Agriculture to issue a booklet entitled: "Fake Antiseptics and the Law," which exposes the methods of the fakers and tells the buyer how to beware. The booklet may be secured free of charge as long as the supply lasts by writing the Food, Drug, and Insecticide Administration, U. S. Department of Agriculture, Washington, D. C.,—U. S. Dept. of Agriculture Office of Information, March 25, 1930.

NEWS

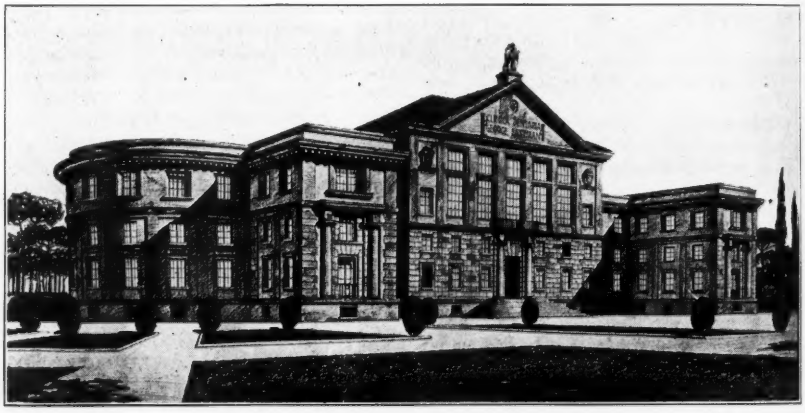
Dr. Hill Appointed to Council on Dental Therapeutics: Announcement is made of the appointment of Thomas J. Hill to the Council on Dental Therapeutics. Dr. Hill is professor of clinical oral pathology and therapeutics in the School of Dentistry, Western Reserve University. With the appointment of Dr. Hill, the membership of the Council is complete for the time being.

Rehwinkel Society Meets: The twentieth annual Midwinter Meeting of the Rehwinkel Dental Society was held at the Masonic Temple, Chillicothe, Ohio, March 22. One hundred and fifty-five were registered, including fourteen past presidents and fifty-seven

of the eighty members of the society. A 100 per cent paid-up membership was reported; three new members were taken in and three were reinstated. There were ten exhibitors. George B. Winter, of St. Louis, Mo., gave two lecture clinics.

Plans Received for Eastman Dental Clinic in Rome: Plans have been received for the Eastman Dental Clinic at Rome, established by the gift of $1,000,000, from Mr. George Eastman, of Rochester, N. Y. Building will proceed as soon as the plans are approved by Mr. Eastman. The site of the clinic, which is to be one-third larger than the Rochester Dental Dispensary, owing to the generous size of the land assigned to the building by the Italian government, is on one of the principal avenues of the city, in close proximity to the medical and hospital center. Facilities provided for carrying on the work of the dispensary and the arrangement of many of the details in the interior are similar to those of the London and Rochester dental clinics established through the generosity of Mr. Eastman. Maintenance and running expenses will be borne by the Italian government, this marking the first time that a national government has guaranteed the maintenance of a dental institution. Dental care for all indigent children up to the age of 16 is the object of the clinic work and any service rendered adults must in no wise interfere with the work for the children. Mr. Eastman and Harvey J. Burkhart, director of the Rochester Dental Dispensary, were recently presented by the King of Italy with medals of the grand officer and officer, respectively, of the Order of the Crown of Italy, the former being with star, the highest decoration that the King of Italy ever bestows. Dr. Burkhart sailed for Rome, April 4. He expects to return about May 15.

Academy of Dental Science Compiles Memoir of Tomes: The American Academy of Dental Science has compiled a memoir of the late Sir Charles Tomes, in grateful appreciation of his services to the public in general and to the dental profession in particular. The memoir is dedicated to the widow, Lady Tomes, of Mannington Hall, Aylsham, Norfolk, England. The memoir quotes the *British Medical Journal:* "The present position of odontology among the medical sciences is largely due to the work and character of two men—John and Charles Tomes." Sir Charles, the son of John Tomes, was elected a Fellow of the Royal Society at the age of 32, because of his original research on the structure and development of the teeth, and he continued to receive honors and have degrees bestowed on him as a result of his scientific work. He wrote extensively on the structure and development of the teeth, especially of the dentin and the enamel organ. Sir Charles was an honorary fellow of the American Academy of Dental Science.



Eastman Dental Clinic, Rome, Italy

Resolution by American Society of Orthodontists: The following resolution was adopted by the American Society of Orthodontists at a recent meeting:

WHEREAS, the correction of dental abnormalities in children is essential to their health and well being, and the need for such care is very apparent among the children of our schools; and

WHEREAS, school authorities in many cities maintain free dental-clinics to care for the children of the poor who require such services and have the full cooperation of school principals and school teachers to the end that such children are sent during school hours for such care without loss of school attendance; and

WHEREAS, the children of taxpayers who patronize private dentists and thereby relieve the schools of the expense incidental to such care are not given the same degree of cooperation from school authorities in meeting this health problem; and

WHEREAS, children who have spent the entire day in school are unfit subjects for difficult or protracted dental operations, nor can such operations be properly and efficiently done under these conditions; and

WHEREAS, the prerogative of parents to keep children out of school for such important and necessary care frequently leads to friction with teachers; therefore, be it

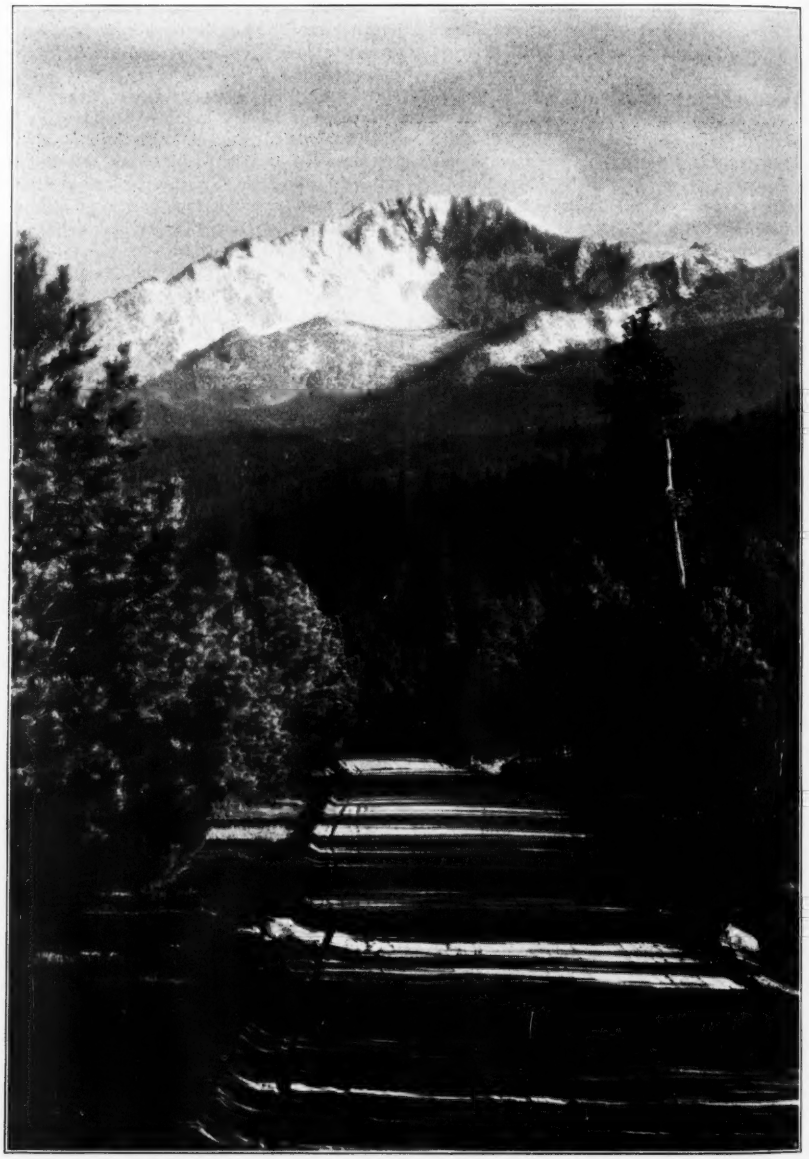
Resolved, that The American Society of Orthodontists does urgently request all agencies interested in child welfare to give consideration to this problem and use their influence to the end that the children of taxpayers may have the cooperation of school authorities in meeting this important health problem; and be it further

Resolved, that this resolution shall be spread on our minutes and copies sent to the leading medical and dental journals and their publication requested.

DEATHS

Bloese, Rudolph H., Chicago, Ill.; Northwestern University Dental School, 1897; died recently, in a fall from the fire escape on the fourth floor of building in which he had his office, where he had gone to feed some pigeons. He had been suffering from dizziness for several weeks. Dr. Bloese was 60 years old.

Brown, John R., Richland Center, Wis.; Marquette University School of Dentistry, 1910; died, January 20, of nephritis; aged 45.



PIKES PEAK FROM ROAD TO WOODLAND PARK, COLORADO
Seventy-Second Annual Session, American Dental Association, Denver, Colo., July 21-25, 1930

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association, Denver, Colo., July 21-25.

American Academy of Periodontology, Colorado Springs, Colo., July 17-19.

American Dental Assistants Association, Denver, Colo., July 21-25.

American Dental Hygienists Association, Denver, Colo., July 21-25.

American Full Denture Society, Denver, Colo., July 18-19.

American Society of Oral Surgeons and Exodontists, Evergreen, Colo., July 18-19.

Australian Dental Association, Brisbane, July 7-12.

International Dental Federation, Paris, France, August, 1931.

International Orthodontic Congress, London, England, July 20-24.

National Association of Dental Examiners, Denver, Colo., July 21-22.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

May

California, at Sacramento (21-24).
Illinois, at Decatur (13-15).
Indiana, at Indianapolis (19-21).
Iowa, at Des Moines (6-8).
Maryland, at Baltimore (5-7).
Massachusetts, at Boston (5-9).
Michigan, at Detroit (5-7).
Missouri, at St. Louis (19-22).
Nebraska, at Lincoln (19-22).
New York, at New York City (12-16).
North Carolina, at Asheville (5-8).
Pennsylvania, at Philadelphia (6-8).
South Carolina, at Columbia (19-21).
South Dakota, at Sioux Falls (12-14).
Tennessee, at Nashville (13-15).
Texas, at Fort Worth (20-23).
Vermont, at Burlington (21-23).
Virginia, at Richmond (12-15).
West Virginia, at Fairmont (19-21).

June

Arkansas, at Little Rock (2-4).
Georgia, at Atlanta (11-13).
Maine, at South Poland (19-21).
New Hampshire, at Laconia (4-6).
Southern California, at Riverside (2-4).

July

Wisconsin, at Milwaukee (8-10).

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Alabama, at Birmingham, June 23. E. W. Patton, Secretary, 1807 Comer Bldg., Birmingham.

Arizona, at Phoenix, July 14. W. M. Johnson, Secretary, 1105 Luhrs Tower Bldg., Phoenix.

Arkansas, at Little Rock, June 23. Floyd P. Travis, Secretary, Osceola.

California, at San Francisco, May 24, and Los Angeles, June 21. Bert Boyd, Secretary, 610 S. Broadway, Los Angeles.

Connecticut, at Hartford, June 25-28. Almond J. Cutting, Recorder, Southington.

Delaware, at Wilmington, June 18-19. W. S. P. Combs, Secretary, Middletown.

Florida, at Jacksonville, June 26-28. R. P. Taylor, Secretary, 414 St. James Bldg., Jacksonville.

Indiana, at Indianapolis, June 12-16. J. M. Hale, Secretary, Mt. Vernon.

Kentucky, at Louisville, June 6-10.

Maine, at Augusta, June 30-July 2. Alton H. Swett, Secretary, 192 State St., Portland.

Massachusetts, at Boston, June 10-14. W. Henry Grant, Secretary, State House, Boston.

Minnesota, at Minneapolis, June 12. W. H. Smith, Secretary, 601 Donaldson Bldg., Minneapolis.

Mississippi, at Jackson, June 17-20. T. Ford Leggett, Secretary, Laurel.

Montana, at Helena, July 14-18. T. P. Regan, Secretary, Helena.

Nebraska, at Lincoln and Omaha, June 10-12, at Lincoln, June 12-14. Mrs. Clark Perkins, Director, Bureau of Examining Boards.

Nevada, at Reno, June 2. G. C. Steinmiller, Secretary, P. O. Box 274, Reno.

New Jersey, at Trenton, June 23. John C. Forsyth, Secretary, 148 W. State St., Trenton.

New Mexico, at Albuquerque, July 16-18. J. J. Clarke, Secretary, Artesia.

North Dakota, at Fargo, July 8-11. Gilbert Moskau, Secretary, Grand Forks.

Oklahoma, at Oklahoma City, June 23-26. E. E. Sanger, Secretary, Yukon.

Pennsylvania, at Philadelphia and Pittsburgh, June 18-21. W. A. McCready, Secretary, 1115 Highland Bldg., Pittsburgh.

Rhode Island, at Providence, June 24-26. Albert Midgley, Secretary, 1108 Union Trust Bldg., Providence.

South Dakota, at Sioux Falls, June 28. G. G. Kimball, Secretary, Mitchell.

Tennessee, at Memphis, June 16. F. W. Meacham, Secretary, 911 Hamilton National Bank Bldg., Chattanooga.

Vermont, at Montpelier, July 1-2. David Manson, Secretary, Burlington.

Virginia, at Richmond, June 10. John M. Hughes, Secretary, 715 Medical Arts Bldg., Richmond.

WISCONSIN STATE DENTAL SOCIETY

The sixtieth annual meeting of the Wisconsin State Dental Society will be held at Milwaukee, July 8-10.

E. E. Parkinson, *Secretary,*
104 King St.
Madison.

FLORIDA STATE BOARD OF DENTAL EXAMINERS

The Florida State Board of Dental Examiners will hold the annual meeting, June 26-28, at Jacksonville. Applications must be in the hands of the secretary twenty days before date of examination. For further information, address

R. P. Taylor, *Sec'y-Treas.,*
414 St. James Bldg.,
Jacksonville.

MONTANA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Montana State Board of Dental Examiners will be held, July 14-18, at Helena. For further information, address

T. P. Regan, *Secretary,*
Helena.

ARKANSAS STATE BOARD OF DENTAL EXAMINERS

The Arkansas State Board of Dental Examiners will meet at 8 a. m., Monday, June 23, at the Lafayette Hotel, Little Rock, for the purpose of examining all applicants possessing the proper credentials. Applications should be in the hands of the secretary at least one week before the board meeting. For application blanks, clinical requirements, etc., address

Floyd P. Travis, *Secretary,*
Osceola.

STATE OF NEBRASKA BUREAU OF EXAMINING BOARDS

The next dental examination will be given, June 9-14. The first three days the practical examination will be given at both Lincoln and Omaha. The last three days, the written examination will be held at the College of Dentistry, University Campus, Lincoln.

Bureau of Examining Boards,
Mrs. Clark Perkins, *Director.*

VERMONT BOARD OF EXAMINERS

The Vermont State Board of Examiners will meet, July 1-2, at the State House, Montpelier, to examine applicants for a license to practice dentistry and dental hygiene. All applications, accompanied by examination fee, must be in the hands of the secretary at least ten days before the date of meeting. For application and other information, address

David Manson, *Secretary,*
Burlington.

BOARD OF DENTAL EXAMINERS OF CALIFORNIA

Examinations to secure a license to practice dentistry in the State of California will be held in San Francisco beginning May 24,

and in Los Angeles beginning June 21. All necessary credentials must be in the hands of the secretary at least twenty days prior to the foregoing dates.

BERT BOYD, *Secretary,*
610 South Broadway,
Los Angeles.

NATIONAL ASSOCIATION OF DENTAL EXAMINERS

The National Association of Dental Examiners will meet in Denver, Colo., July 21-22.

GEORGE L. POWERS, *Sec'y-Treas.,*
Memphis, Tenn.

AMERICAN ACADEMY OF PERIODONTOLOGY

The seventeenth annual meeting of the American Academy of Periodontology will be held at the Acacia Hotel, Colorado Springs, Colo., July 17-19.

CLYDE C. SHERWOOD, *President,*
Toledo, Ohio.
CLAYTON H. GRACEY, *Sec'y-Treas.,*
269 Rowena St.,
Detroit, Mich.

SIGMA EPSILON DELTA NEW YORK GRADUATE CHAPTER

The New York Graduate Chapter of the Sigma Delta Fraternity has arranged for headquarters at the Hotel Commodore, New York City, during the New York State Dental Society Convention, May 12-16.

MITCHELL L. ROSENSON, *Master,*
N. Y. Graduate Chapter.
EDWARD LUSTERMAN, *Scribe,*
185 West End Ave.,
Manhattan Beach.

GEORGIA DENTAL HYGIENIST ASSOCIATION

The Georgia Dental Hygienist Association will hold its annual meeting, June 11, at the Ansley Hotel, Atlanta. Members of the dental profession, dental assistants and dental hygienists are invited to attend.

ADDIBEL FORRESTER, *Secretary,*
803 Atlanta National Bank Bldg.,
Atlanta.

STATE BOARD OF DENTAL EXAMINERS, STATE OF OKLAHOMA

(Change of Date)

The next examination of the Oklahoma State Board of Dental Examiners will be held, June 23-26, at Oklahoma City.

E. E. SANGER, *Sec'y-Treas.,*
Yukon.

TENNESSEE BOARD OF DENTAL EXAMINERS

The Tennessee Board of Dental Examiners will meet at 9 a. m., June 16, at the Dental Department, University of Tennessee, Memphis, for the purpose of examining all applicants who present credentials acceptable to the Board. Hygienists will also be examined. Credentials must be brought for examination by the entire Board. Applications should be in the hands of the secretary five days before the meeting. For application blank and clinical requirements, address

F. W. MEACHAM, *Sec'y-Treas.,*
911 Hamilton National Bank Bldg.,
Chattanooga.

MISSISSIPPI STATE BOARD OF DENTAL EXAMINERS

The next meeting of the State Board of Dental Examiners of Mississippi will be held, June 17-20, at Jackson.

T. FORD LEGGETT, *Secretary,*
Laurel.

NEW MEXICO BOARD OF DENTAL EXAMINERS

The next meeting of the New Mexico Board of Dental Examiners will be held at Albuquerque, July 16-18, for the purpose of examining applicants for the practice of dentistry. The application, with the fee and photograph, must be in the hands of the secretary by July 1. For blank and information, address

J. J. CLARKE, *Sec'y-Treas.,*
Artesia.

WOMAN'S AUXILIARY, A. D. A.

The Woman's Auxiliary of the American Dental Association invites and urges the

wives of all members of the Association to become members of the auxiliary. The dues are $1, payable to the treasurer, Mrs. Alexander H. Reynolds, 4630 Chester Ave., Philadelphia, Pa.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the North Carolina State Board of Dental Examiners will be held in Raleigh, June 16-19. For further information and application blanks, address

H. L. KEITH, *Secretary,*
409 North Carolina Bank & Trust Bldg.,
Wilmington.

MASSACHUSETTS BOARD OF DENTAL EXAMINERS

The Masschusetts Board of Dental Examiners will hold an examination for registration for both dentists and oral hygienists in the City of Boston, June 10-14. Full information, application blanks, etc., may be secured at the office of the secretary, Room 146, State House, Boston. All applications must be filed at the office of the secretary at least ten days before the date set for the examination.

W. HENRY GRANT, *Secretary.*

SOUTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the South Dakota Board of Dental Examiners will be held at the Carpenter Hotel, Sioux Falls, beginning Thursday, June 26.

G. G. KIMBALL, *Secretary,*
Mitchell.

ARIZONA BOARD OF DENTAL EXAMINERS

The next meeting of the Arizona State Board of Dental Examiners will be held the week commencing Monday, July 14, in Phoenix. Applications must be in the hands of the secretary not later than June 30. For further information, address

WILLIAM J. JOHNSON, *Secretary,*
1105 Luhrs Tower Bldg.,
Phoenix.

NORTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The North Dakota State Board of Dental Examiners will hold the next meeting at Fargo, July 8-11. Applications for examination must be in the hands of the secretary by July 1.

GILBERT MOSKAU, *Secretary,*
Grand Forks.

PENNSYLVANIA STATE BOARD OF DENTAL EXAMINERS

The Pennsylvania State Board of Dental Examiners will hold its next examinations, June 18-21, at Philadelphia and Pittsburgh. Applicants should apply to the Department of Public Instruction, Harrisburg, for the necessary blanks and, on return of same with fee and photographs at least ten days before the date of examination, instructions order and place of examinations will be sent to applicant.

W. A. MCCREADY, *Secretary,*
1115 Highland Bldg.,
Pittsburgh.

ALUMNI SOCIETY OF PHILADELPHIA DENTAL COLLEGE AND TEMPLE UNIVERSITY DENTAL SCHOOL

(Change of Date)

The annual meeting of the Alumni Society of Philadelphia Dental College and Temple University Dental School will be held in Philadelphia, Monday, May 5.

RAYMOND T. WYCKOFF, *Chairman,*
Journal and Press.

AN IMPOSTER

A man has been operating in West Virginia collecting instruments to be repaired and never returning them. He is described as about 45 years of age, and has black hair streaked with grey. His height is 5 feet, 7 inches; weight about 140 pounds. He wears glasses, and his teeth are in bad condition. A warrant is now out for his arrest. Anyone apprehending this man please communicate with M. H. Nicholson, secretary-treasurer of the Mercer Mingo and McDowell Dental Society, Bluefield, W. Va.

A WARNING

A member of the Association practicing in Rockford, Ill., reports the receipt of a bad check given him by a stranger who is described as of fair complexion, with dark hair and dark eyes, about 30 to 35 years old, height, 5 feet, 5 inches, weight about 135 pounds. The two upper central incisors are about one-fourth inch apart and the upper lateral incisors are missing. The upper right and left cuspids have been prepared for three-quarter or shell crowns. The first molars are missing. His approach is made by an offer of a down-payment before the work is started and he seems quite familiar with the work that is needed. Several dentists in the vicinity have been duped by this man.

Wheat field, Colorado. "Plains greater and grander than those of Lombardy."

Fern Lake, Rocky Mountain National Park, Colorado.

The July meeting of the American Dental Association promises to be a red letter event in the lives of many of our members. So much of America's wonderful scenic splendor is adjacent to Denver that just to attend the meeting and return home without having adventured into the glories of the Rocky Mountains would be almost an affront to Nature.

Plans are complete for an all-expense trip to the convention, visiting also the Royal Gorge and the highest bridge in the world; Colorado Springs and Pikes Peak; Yellowstone National Park; Glacier National Park; a motor trip over the Great Divide into the Canadian Rockies, and return home; with Pullman sleeper, meals on train and hotel accommodation (but not meals in Denver), all included in the one scheduled price.

L. L. Davis, 58 East Washington St., Chicago, Ill., chairman of post-convention transportation, has all the details of the trip and will answer all inquiries.

AMERICAN DENTAL ASSOCIATION

Denver, Colorado. July 21-25, 1930.

HOTEL RESERVATIONS

In securing hotel reservations for the 1930 Session, consult the hotel rate-sheet and fill out the blank application below. Mail immediately to the hotel you wish to patronize. The hotel will then advise you of the reservation that has been made for you.

Kindly indicate second and third choices.

Please remember that reservation constitutes a contract with the hotel to provide you with the accommodations you desire. If you find it impossible to carry out your part of the contract, please write or wire the hotel, releasing it.

MAIL THIS APPLICATION DIRECT TO THE HOTEL

HOTEL RESERVATION

AMERICAN DENTAL ASSOCIATION, DENVER, COLO., JULY 21-25, 1930.

.....Hotel. 1930

Please reserve sleeping room accommodations noted below:

.....Room(s) with bath for.....people. Rate desired $..... (per day)

.....Room(s) without bath for.....people. Rate desired $..... (per day)

Second choice: .....

Third choice: .....

ROOMS TO BE OCCUPIED BY:	ADDRESS IN FULL
.....	.....
.....	.....
.....	.....

Please confirm this reservation to applicant. I further agree to notify the hotel at once in the event I am unable to use this reservation.

IMPORTANT TO HOTEL MANAGER: In the event you cannot accept this reservation, please forward this application at once to Dr. I. R. Bertram, Chairman Halls and Hotels, 1222 Republic Bldg., Denver, Colorado, who will attend to its assignment.

HOTEL	Rooms	Single with Bath	Double with Bath	Single without Bath	Double without Bath
ADAMS 18th & Welton	115	$3.00-5.00	$4.00-6.00	$2.00-2.50	$3.00-4.00
AMBASSADOR 1728 California	92	2.00	2.50	1.50	2.00
ALBANY 17th & Stout	300	3.00-6.00	5.00-10	2.00-3.00	4.00-6.00
ARGONAUT 233 E. Colfax	160	4.00	5.50	2.00	3.00
AUDITORIUM 14th & Stout	200	2.00-3.50	3.00-5.00	1.50-2.00	2.50-3.00
AYRES 1441 Logan	75	3.50 up	5.00-6.00	2.50	4.00
BROWN PALACE 17th & Tremont	300	5.00 up	8.00 up		
COLBURN 10th & Grant	100	3.50-5.00	5.00-8.00		
COLORADO 17th & Tremont	100	2.50-3.00	4.00-5.00	1.50-2.00	2.50-3.00
COSMOPOLITAN 18th & Broadway	460	3.00-5.00	5.00-10.00	1.50-2.00	2.50-4.00
CREST 1924 Welton	114	2.00 up	3.00 up	1.50	2.00
EDELWEISS 1651 California	76	3.00	4.00	2.00	3.00
HARVARD 501 E. Colfax	60	2.50	3.50	1.50	2.50
KENMARK 530 17th	120	2.50-3.50	4.00-6.00	1.50-2.50	2.50-4.00
LANCASTER 1765 Sherman	75	2.50	3.00-5.00	2.00	2.50
MARQUETTE 1725 Curtis	62	2.00	4.00	3.00	3.00
MAYFLOWER 1710 Grant	80	2.50-3.50	3.50-5.00	1.50-2.00	3.00-3.50

(*Continued on next page*)

HOTEL	Rooms	Single with Bath	Double with Bath	Single without Bath	Double without Bath
MIDLAND 1106 17th	70	3.00	4.00	1.50-3.00	2.00-3.00
MILLS 1321 Logan	60	2.50	4.00	1.50	2.00
NEWHOUSE 1470 Grant	77	3.00	5.00	2.00-2.50	3.00-3.50
OLIN 1420 Logan	125	2.50-4.00	6.00		
O'NEILL 1407 Stout	60	2.00	3.50	1.50	2.50
OXFORD 1612 17th	250	3.50	5.00	2.00	3.50
PAGE 1320 Stout	65	2.00-2.50	3.00-3.50	1.50	2.00
PARK LANE 450 S. Marion			10.00		
PLAZA 330 15th	60	2.00-2.50	3.00-3.50	1.50	2.00-2.50
SEARS 1755 California	94	2.50-3.00	3.00-8.00	2.00	2.50-3.00
SHIRLEY-SAVOY 17th & Broadway	400	3.00-5.00	5.00-8.00	2.00-2.50	3.50-4.00
STANDISH 1530 California	125	2.50	3.50	1.50	2.50
WELLINGTON 1450 Grant	75		3.50		
WEST 1337 California	112	2.50	3.50	1.25-1.50	2.00-2.50
WYNNE 1431 California	100	2.00 up	3.00 up	1.50	2.00
WEST COURT 1415 Glenarm Place	129	2.50 up	3.00 up	1.50	2.00

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1929-1930

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